

दिल्ली विश्वविद्यालय  
**UNIVERSITY OF DELHI**



**Bachelor of Science (Hons) Food Technology**  
**(Effective from Academic Year 2019-20)**

**SYLLABUS AND SCHEME OF EXAMINATION FOR B.SC. (HONS)  
FOOD TECHNOLOGY**

**Three Year Full Time Programme  
(Choice Based Credit System)**



**Syllabus applicable for students seeking admission in 2019 onwards**

**DEPARTMENT OF HOME SCIENCE**

**FACULTY OF SCIENCE**

**UNIVERSITY OF DELHI**

**Approved in AC Meeting 15.07.2019**

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## **Preamble**

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The University of Delhi envisions all its programmes in the best interest of their students and in this endeavour it offers a new vision to all its Under-Graduate courses. It imbibes a Learning Outcome-based Curriculum Framework (LOCF) for all its Under Graduate programmes.

The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the undergraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students' experiences as they engage themselves in the programme of their choice. The Under-Graduate Programmes will prepare the students for both, academia and employability.

Each programme vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The programmes also state the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice and also skills for employability. In short, each programme prepares students for sustainability and life-long learning.

The new curriculum of B.Sc. (Hons) Food Technology offers the students to gain the requisite knowledge, skills and aptitude for the field of food technology. The efforts are made to measure cognitive as well as applied learning. Students are not only trained on the core components but also in areas which are need based, innovative and relevant keeping in pace with the fast growing food industry. The course is internationally competitive.

The University of Delhi hopes the LOCF approach of the programme B.Sc. (Hons) Food Technology will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

## **1. Introduction to B.Sc. (Hons) Food Technology**

The Food Technology course at the Bachelors level is being run in the University of Delhi since the last 25 years and was introduced by the Faculty of Science from the academic year 1989-1990. The new course has been prepared keeping in view, the unique requirements of B.Sc. (H) Food Technology students. The Food Technology course in Choice Based Credit System is of 3-year duration which comprises of 6 semesters, divided into 14 Core papers, 4 Discipline Specific Elective courses (DSE), 2 Skill Enhancement Elective Courses (SEC) and 4 Generic Elective (GE) Courses. Each year consists of 2 semesters. This course has been prepared keeping in view, the unique requirements of B.Sc. Hons Food Technology students.

The objectives of the course are:

- To impart knowledge in areas related to Food Science and Technology.
- To enable the students to understand the food composition along with its physico- chemical, nutritional, microbiological and sensory aspects.
- To acquaint the students with the technologies of food processing and preservation of plant and animal foods; cereals, pulses, oilseeds, fruits vegetables, spices, meat, fish, poultry, sea food, milk and dairy products.
- To stress on the importance of food safety and quality management, national and international food laws and regulations as well as importance of food engineering and packaging in food industry.

The course contents have been so designed that it can keep pace with the rapidly growing food industry. Since, Food Technology is an interdisciplinary science it is recommended that subjects like Biochemistry, Biology, Chemistry, Maths, Statistics, Biostatistics, Physics etc be preferably chosen as the Generic elective(GE) by the students as they are synergistic to the curriculum. However, students are free to pick up any of the Generic Elective Courses offered by other departments.

## **2. Learning Outcome Based Curriculum Framework**

### **2.1 Nature and Extent of the Programme in B.Sc. (Hons) Food Technology**

The learning outcomes-based curriculum framework is based on the premise that every student and graduate is unique. Each student or graduate has his/her own characteristics in terms of previous learning levels and experiences, life experiences, learning styles and approaches to future career-

related actions. The quality, depth and breadth of the learning experiences made available to the students while at the higher education institutions help develop their characteristic attributes.

## **2.2 Aims of Bachelor Degree Programme in B.Sc. (Hons) Food Technology**

The key objectives that underpin curriculum planning and development at the undergraduate level include Programme Learning Outcomes, and Course Learning Outcomes. For the B.Sc. (H) Food Technology course it includes:

- To demonstrate comprehensive knowledge and understanding of the food technology curriculum.
- To apply the principles of food science to preserve, process and package to assure the quality and safety of food products.
- To understand that the real-world problems in the food industry requires continuous acquisition of knowledge and its application to improve the safety and quality of a given food or process.
- To analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.
- To acquire knowledge and skills, including “learning how to learn“, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
- To use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources.
- To acquire professional competency and entrepreneurial skills for economic empowerment.
- To demonstrate the ability to acquire, analyze, interpret and appropriately present laboratory data.

### **3. Graduate Attributes in B.Sc. (Hons) Food Technology**

#### **Disciplinary knowledge**

Students are able to demonstrate comprehensive knowledge and understanding of one or more disciplines such as chemistry, bio-chemistry, mathematics, statistics, microbiology, engineering, management; regulations with support of different allied subjects of Life Science; Physical Science.

#### **Communication Skills**

Development of students' communication skills is planned through an AECC paper (English) which is compulsory for each student. Besides that the students do various assignments that enable them to develop skills in public speaking writing and effective's interpersonal skills. Presentations in each paper enhances their confidence, ability to express themselves; presentation skills.

#### **Research-related skills**

Students develop a scientific temper and a sense of enquiry through various food technology papers. They have capabilities in asking relevant questions relating to current issues and themes and state hypothesis and rationale for inquiry. Students are capable of using appropriate research methodology especially for understanding safety issues in Food Technology and reporting the results in different formats.

#### **Cooperation/Team work**

Students are capable of effective working in diverse contexts and teams in class rooms laboratories, student societies, industry and the community. They have basic management skills for independently organizing events, resource mobilization and leading community based projects, initiatives; cultural shows.

#### **Self-directed learning**

Students are capable of working independently and are able to apply the concepts of Food Technology in an original; creative manner to solve and manage real life issues for the customers and industry. Students develop customized products as per the requirements of customers eg. Sugar free jams; sweets for diabetics, gluten free products for celiacs etc.

### **Multicultural competence**

Students are confident of working in diverse socio-cultural contexts. They are able to effectively engage with multicultural groups and teams. They have sensitivities of cross cultural and ethnic diversity which they can apply to different settings. College through a student and faculty exchange program with foreign university helps them to acquire multicultural competency. They are competent to seek higher education in foreign universities.

### **Moral and ethical awareness/reasoning**

Student has awareness of ethical conduct in different situations (academic and personal). They have skills in understanding and avoiding unethical behavior such as misrepresentation, plagiarism and environmental misuse and violence. They are formally taught ethics of research and human interventions.

### **Leadership readiness/qualities**

Students have leadership qualities in organizing teams and their mobilization for effective problem solving in different Food Technology aspects. Students apply creative leadership for realization of various goals. As a leader, they are trained to have greater customer sensitivity and connect. They can organize food courts and design business plans.

### **Lifelong learning**

Students acquire ability to gain knowledge and skills which are necessary in life for the holistic development for meeting their professional and personal needs in varying environment and changing contexts.

## **4. Qualification Descriptors for B.Sc. (Hons) Food Technology**

The following descriptors indicate the expectations from B.Sc. Hons Food Technology:

- The students will have a sound knowledge of Food Science and Technology.
- They will understand the technologies of food processing and preservations of all food groups.
- They will understand food composition, nutritional, microbiological and sensory aspects.
- They will understand food safety and standards, both nationally and internationally.



- They will be versant with key principles of food engineering and packaging.

## **5. Programme Learning Outcome in B.Sc. (Hons) Food Technology**

The learning outcome of the course are-

- Knowledge of various areas related to Food science and technology,
- Understanding of the food composition and its physico- chemical, nutritional, microbiological and sensory aspects,
- Know how of processing and preservation techniques of pulses, oilseeds, spices, fruits and vegetables, meat, fish, poultry, milk & milk products,
- Relevance and significance of food safety, food quality ,food plant sanitation, food laws and regulations, food engineering and packaging in food industry.

## **6. Structure of B.Sc. (Hons) Food Technology**

The B.Sc. (Hons) Food Technology programme will be of three years duration. Each year will be called an academic year and will be divided into two semesters, thus there will be a total of six semesters. Each semester will consist of sixteen weeks.

The programme will consist of core papers, general electives and discipline electives of 6 credits, 4 credits theory and 2 credits practical courses. Skill enhancement courses are 4 credits courses which comprise of practicals or theory 2 credits and Practical 2 credits. For theory classes 1 credit indicates a one hr lecture per week while for Practical 1 credit indicates a two hour session per week.

The programme includes Core Courses (CC) and elective courses. The core courses are all compulsory courses. There are three kinds of elective courses: Discipline-Specific Elective (DSE), Generic Elective (GE) and Skill Enhancement Course (SEC). In addition there are two compulsory Ability Enhancement Courses (AEC).

To acquire a degree in Food Technology a student must study fourteen Core Courses, four Discipline-Specific Electives, four Generic Electives, two Skill Enhancement Courses and two compulsory Ability Enhancement Courses. The Core Courses, Discipline-Specific Electives and Generic Electives are six-credit courses. The Skill Enhancement Courses are four-credit courses while the Ability Enhancement

Courses are two credit-courses. A student has to earn a minimum of 148 credits to get a degree in B.Sc. (Hons) Food Technology.

There will be fourteen Core Courses which are to be compulsorily studied to complete the requirements for an Honours degree in B.Sc. Home Science. The students will study two Core Courses each in Semesters I and II, three Core Courses each in Semesters III and IV, and two Core Courses each in Semesters V and VI. The Core Courses will be of six credits each (four credits theory and two credits Practicals).

The programme offers 6 Discipline-Specific Electives (DSEs), of which the student must choose any two in each of the Semesters V and VI. The DSEs will be of six credits each (four credits theory and two credits Practicals). A particular option of DSE course will be offered in Semesters V and VI semesters only if the minimum number of students opting for that course is 10.

Six Generic Elective (GE) courses will be offered to the students of the B.Sc. Hons Food Technology programme by other departments and the student will have the option to choose one GE course each in Semesters I, II, III, and IV. The GEs will be of six credits each (four credits theory and two credits Practicals).

The students will undertake two Skill Enhancement (SE) courses of four credits each in Semesters III and IV, which they can choose from the list of SE courses offered by their college. The SE courses will be of four credits each (two credits theory and two credits Practicals). The Department of Food Technology is offering five such courses.

The two compulsory Ability Enhancement Courses (AECs): AE1 (Environmental Sciences) and AE2 (English communication) will be of four credits each (theory only). The student will take one each in Semesters I and II.

The teaching learning will involve theory classes of one hour duration and practical classes. The curriculum will be delivered through various methods including chalk and talk, powerpoint presentation, audio, video tools, e-learning/e-content, field trips/ industry visits, seminars, workshops, projects and class discussions. The assessment broadly will comprise of internal assessment (25%) and End Semester examination (75%). The internal assessment will be through MCQs, test, assignment, oral presentation, quizzes and worksheets. Each practical paper will be of 50 marks.

## 6.1. Credit Distribution in B.Sc. (Hons.) Food Technology

CORE courses			
Semester	Course Code	Course Name	Credits (Th.+Pr.)
I	CC FT101	Fundamentals of Food Technology	4 +2
	CC FT102	Principles of Food Science	4 +2
II	CC FT 201	Technology of Food Preservation	4 +2
	CC FT 202	Food Processing Technology	4 +2
III	CC FT 301	Food and Nutrition	4 +2
	CC FT 302	Technology of Fruits, Vegetables and Plantation Crops	4 +2
	CC FT 303	Technology of Dairy and Sea Food	4 +2
IV	CC FT 401	Technology of Cereals, Pulses and Oilseeds	4 +2
	CC FT 402	Food Microbiology	4 +2
	CC FT 403	Technology of Meat, Poultry and Egg	4 +2
V	CC FT 501	Food Engineering	4 +2
	CC FT 502	Food Chemistry-I	4 +2
VI	CC FT 601	Food Chemistry-II	4 +2
	CC FT 602	Food Quality And Sensory Evaluation	4 +2

**DISCIPLINE SPECIFIC ELECTIVE COURSES**

<b>Semester</b>	<b>Course Code</b>	<b>Course Name</b>	<b>Credits (Theory+Pr)</b>
V and VI	<b>DSE FT 01</b>	Food Safety	4+2
DSE 1  (Any One)	<b>DSE FT 02</b>	Food Quality Management	
	<b>DSE FT 03</b>	Bakery Technology	
	<b>DSE FT 04</b>	Food Packaging	
	<b>DSE FT 05</b>	Nutraceutical and Functional foods	
	<b>DSE FT 06</b>	Food Plant Sanitation	
DSE II  (Any One)	<b>DSE FT 01</b>	Food Safety	4+2
	<b>DSE FT 02</b>	Food Quality Management	
	<b>DSE FT 03</b>	Bakery Technology	
	<b>DSE FT 04</b>	Food Packaging	
	<b>DSE FT 05</b>	Nutraceutical and Functional foods	
	<b>DSE FT 06</b>	DSE FT06 Food Plant Sanitation	

<b>SKILL ENHANCEMENT ELECTIVE COURSES</b>			
<b>Semester</b>	<b>Course Code</b>	<b>Course Name</b>	<b>Credits (Theory+Pr)</b>
III & IV	<b>SEC FT 01</b>	Entrepreneurship Development	4
	<b>SEC FT 02</b>	Food Product Development	
	<b>SEC FT 03</b>	Food Fermentation Technology	
	<b>SEC FT 04</b>	Confectionary Technology	
	<b>SEC FT 05</b>	Project and Technical Report	

<b>GENERIC ELECTIVE COURSES</b>			
<b>Semester</b>	<b>Course Code</b>	<b>Course Name</b>	<b>Credits (Theory+Pr)</b>
I, II, III and IV	<b>GE FT 01</b>	Food Processing and Preservation	4+2
	<b>GE FT 02</b>	Chemistry of Food	
	<b>GE FT 03</b>	Sensory Evaluation of Food	
	<b>GE FT 04</b>	Food Microbiology and Food Safety	
	<b>GE FT 05</b>	Food Engineering and Packaging	
	<b>GE FT 06</b>	Technology of Plant and Animal Foods	

## 6.2. Semester-wise Distribution of Courses

Semester	Course Opted	Course Name	Credits
I	Ability Enhancement Compulsory Course - I	English Communications/ Environmental Science	4
	CC FT 101 Theory	Fundamentals of Food Technology	4
	CC FT 101 Practical	Fundamentals of Food Technology Practical	2
	CC FT 102 Theory	Principles of Food Science	4
	CC FT 102 Practical	Principles of Food Science Practical	2
	GE FT -1 Theory	GE -1	4
	GE FT -1 Practical	GE -1 Practical	2
II	Ability Enhancement Compulsory Course - II	English Communications/ Environmental Science	4
	CC FT 201 Theory	Technology of Food Preservation	4
	CC FT 201 Practical	Technology of Food Preservation Practical	2
	CC FT 202 Theory	Food Processing Technology	4
	CC FT 202 Practical	Food Processing Technology PRACTICAL	2
	GE FT -2 Theory	GE -2 Theory	4
	GE FT -2 Practical	GE – 2 Practical	2
III	CC FT 301 Theory	Food and Nutrition	4
	CC FT 301 Practical	Food and Nutrition Practical	2
	CC FT 302 Theory	Technology of Fruits, Vegetables and Plantation Crops	4
	CC FT 302 Practical	Technology of Fruits, Vegetables and Plantation Crops Practical	2
	CC FT 303 Theory	Technology of Dairy and Sea Food	4
	CC FT 303 Practical	Technology of Dairy and Sea Food Practical	2
	SEC FT 1	SEC-1	4
	GE FT -3 Theory	GE -3 Theory	4
	GE FT -3 Practical	GE – 3 Practical	2
	IV	CC FT 401 Theory	Technology of Cereals, Pulses and Oilseeds
CC FT 401 Practical		Technology Of Cereals, Pulses And Oilseeds	2

		Practical	
	CC FT 402 Theory	Food Microbiology	4
	CC FT 402 Practical	Food Microbiology Practical	2
	CC FT 403 Theory	Technology of Meat, Poultry and Egg	4
	CC FT 403 Practical	Technology of Meat, Poultry and Egg Practical	2
	SEC FT -2	SEC - 2	4
	GE FT -4 Theory	GE - 4 Theory	4
	GE FT – 4 Practical	GE - 4 Practical	2
V	CC FT 501 Theory	Food Engineering	4
	CC FT 501 Practical	Food Engineering Practical	2
	CC FT 502 Theory	Food Chemistry-I	4
	CC FT 502 Practical	Food Chemistry-I Practical	2
	DSE 1 Theory	DSE -1 Theory	4
	DSE 1 Practical	DSE -1 Practical	2
	DSE 2 Theory	DSE -2 Theory	4
	DSE 2 Practical	DSE -2 Practical	2
VI	CC FT 601 Theory	Food Chemistry-II	4
	CC FT 601 Practical	Food Chemistry-II Practical	2
	CC FT 602 Theory	Food Quality and Sensory Evaluation	4
	CC FT 602 Practical	Food Quality and Sensory Evaluation practical	2
	DSE 3 Theory	DSE -3 Theory	4
	DSE 3 Practical	DSE -3 Practical	2
	DSE 4 Theory	DSE -4 Theory	4
	DSE 4 Practical	DSE -4 Practical	2
		Total	148Credits

**Total Credits: 84 CC + 24 DSE + 8 SEC + 8 AECC + 24 GE = 148 Credits**

## **7. Courses for Programme for B.Sc. (Hons) Food Technology**

### **Core Course (14 Courses) Total Credits 84**

**Credits – 6 Each (4 Credits Theory + 2 Credits Practical = 6)**

**CC FT 101–Fundamentals of Food Technology:** 4 Credits Theory + 2 Credits Practical

**CC FT 102-Principles of Food Science:** 4 Credits Theory + 2 Credits Practical

**CC FT 201- Technology of Food Preservation:** 4 Credits Theory + 2 Credits Practical

**CC FT 202- Food Processing Technology:** 4 Credits Theory + 2 Credits Practical

**CC FT 301-Food and Nutrition:** 4 Credits Theory + 2 Credits Practical

**CC FT 302- Technology of Fruits, Vegetables and Plantation Crops:** 4 Credits Theory + 2 Credits Practical

**CC FT 303-Technology of Dairy and Sea Food:** 4 Credits Theory + 2 Credits Practical

**CC FT 401- Technology of Cereals, Pulses and Oilseeds:** 4 Credits Theory + 2 Credits Practical

**CC FT 402- Food Microbiology:** 4 Credits Theory + 2 Credits Practical

**CC FT 403- Technology of Meat, Poultry and Egg:** 4 Credits Theory + 2 Credits Practical

**CC FT 501-Food Engineering:** 4 Credits Theory + 2 Credits Practical

**CC FT 502-Food Chemistry-I:** 4 Credits Theory + 2 Credits Practical

**CC FT 601-Food Chemistry-II:** 4 Credits Theory + 2 Credits Practical

**CC FT 602-Food Quality and Sensory Evaluation:** 4 Credits Theory + 2 Credits Practical

### **Discipline Specific Elective (Any Four) (4 X 6 = 24 Credits)**

**Credits – 6 Each (4 Credits Theory + 2 Credits Practical = 6)**

**DSE FT 01 Food Safety:** 4 Credits Theory + 2 Credits Practical

**DSE FT 02 Food Quality Management:** 4 Credits Theory + 2 Credits Practical

**DSE FT 03 Bakery Technology:** 4 Credits Theory + 2 Credits Practical

**DSE FT 04 Food Packaging:** 4 Credits Theory + 2 Credits Practical

**DSE FT 05 Nutraceutical and Functional Foods:** 4 Credits Theory + 2 Credits Practical

**DSE FT 06 Food Plant Sanitation:** 4 Credits Theory + 2 Credits Practical

### **Skill Enhancement Elective Course (Any Two) (4+4 = 8)**

**Credits – 4 Each**

**SEC FT 01 Entrepreneurship Development:** 2 Credits Theory + 2 Credits Practical

**SEC FT 02 Food Product Development:** 2 Credits Theory + 2 Credits Practical

**SEC FT 03 Food Fermentation Technology:** 2 Credits Theory + 2 Credits Practical

**SEC FT 04 Confectionary Technology:** 2 Credits Theory + 2 Credits Practical

**SEC FT 05 Project and Technical Report:** 4 Credits Practical



**Generic Elective (Any Four) (4 X 6 = 24)**

**Credits – 6 Each (4 Credits Theory + 2 Credits Practical = 6)**

**GE FT 01. Food Processing and Preservation:** 4 Credits Theory + 2 Credits Practical

**GE FT 02. Chemistry of Food:** 4 Credits Theory + 2 Credits Practical

**GE FT 03. Sensory Evaluation of Food:** 4 Credits Theory + 2 Credits Practical

**GE FT 04. Food Microbiology and Food Safety:** 4 Credits Theory + 2 Credits Practical

**GE FT 05. Food Engineering and Packaging:** 4 Credits Theory + 2 Credits Practical

**GE FT 06. Technology of Plant and Animal Foods:** 4 Credits Theory + 2 Credits Practical

**Total Credits: 84 CC + 24 DSE + 8 SEC + 8 AECC + 24 GE = 148 Credits**

# CORE COURSES

## CC FT 101: FUNDAMENTALS OF FOOD TECHNOLOGY (CREDITS: THEORY-4, PRACTICAL-2)

### COURSE OBJECTIVES

- To understand the principles of food science, different areas of food science and the historical evolution of food processing all over the world.
- To understand the basics of plant and animal foods, their types, structure and composition, nutritional value, changes taking place during storage and different processing methods used.

### COURSE LEARNING OUTCOMES

After completion of the course, students will be able to:

- Understand the history and evolution of food processing
- Acquire knowledge of the structure, composition, nutritional quality and post harvest changes in various plant foods
- Understand the structure and composition of various animal foods
- Get an overview of some of the methods of processing of plant and animal foods

**THEORY:        CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

#### UNIT I

##### **Introduction**

**4**

History and evolution of food processing technology

Stewart, G.F., & Amerine, M.A.(2012). *Introduction to Food Science and Technology*. Elsevier, 2nd Edition. Chapter 1

#### UNIT II

##### **Compositional, Nutritional and Technological aspects of Plant foods**

- **Cereals and Millets** **14**
  - Structure and composition of cereals and millets
  - Wheat- structure and composition, types (hard, soft/ strong, weak) Diagrammatic representation of longitudinal structure of wheat grain.
  - Malting, gelatinization of starch, types of browning- Maillard & caramelization.
  - Rice- structure and composition, parboiling of rice- advantages and disadvantages
- **Pulses** **5**
  - Structure and composition of pulses, toxic constituents in pulses, processing of pulses- soaking, germination, decortication, cooking and fermentation.
  -

- **Fats and Oils** **7**
  - Classification of lipids, types of fatty acids - saturated fatty acids, unsaturated fatty acids, essential fatty acids, trans fatty acids.
  - Refining of oils, methods of refining- their advantages and limitations, hydrogenation
  - Rancidity –Types- hydrolytic and oxidative rancidity and its prevention.
  
- **Fruits and Vegetables** **7**
  - Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Dietary fibre.
  - Post harvest changes in fruits and vegetables – Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes,
  - chemical changes, Pathological changes during the storage of fruits and vegetables.

Srilakshmi, B.(2002). *Food science*. New Age Publishers. Chapter 2, 3, 8,10

### UNIT III

#### Compositional, Nutritional and Technological aspects of Animal foods

- **Flesh Foods - Meat, Fish, Poultry** **13**
  - Meat - Definition of carcass, concept of red meat and white meat, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat.
  - Fish - Classification of fish, aquaculture, composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical.
  - Poultry - Structure of hen's egg, composition and nutritive value, egg proteins, characteristics of fresh egg, deterioration of egg quality, difference between broiler and layers.
  
- **Milk and Milk Products** **10**
  - Definition of milk, chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization, an overview of types of market milk and milk products.

Srilakshmi, B.(2002). *Food science*. New Age Publishers. Chapter 5, 6, 7

<b>PRACTICAL</b>	<b>CONTENT</b>	<b>DURATION: 60 HRS (CREDITS 2)</b>
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- To study different types of browning reactions: enzymatic and non enzymatic.
- To study gelatinization behavior of various starches
- To study the concept of gluten formation of various flours.
- To study malting and germination.
- To study dextrinization in foods.
- Identification of pigments in fruits and vegetables and influence of pH and heat on them.
- Quality inspection of animal foods- egg, meat, fish etc

## COMPULSORY READINGS

- Bawa. A.S., Chauhan, O.P, Raju. P.S.(2013) ed. *Food Science*. New India Publishing agency
- Potter, N. N., & Hotchkiss, J. H. (2012). *Food science*. Springer Science & Business Media.
- Srilakshmi, B.(2002). *Food science*. New Age Publishers.

## ADDITIONAL RESOURCES

- De, Sukumar. (2007). *Outlines of Dairy Technology*.Oxford University Press
- Kent, N.L.(1994). *Kent's Technology of Cereals: An introduction for students of food science and agriculture*. Elsevier.
- Meyer. (2004). *Food Chemistry*. New Age
- Stewart, G.F., &Amerine, M.A.(2012). *Introduction to Food Science and Technology*. Elsevier, 2nd Edition.

## TEACHING LEARNING PROCESS

- Lecture method
- Power point presentation
- Projects
- Practicals

## ASSESSMENT METHODS

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

## KEYWORDS

Food Technology, Fundamentals, cereals, millets, pulses, fats and oils, meat, fish, poultry, milk

### Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	An overview of the history of food processing technology and how food technology evolved with time since the ancient period till present scenario both in India and worldwide.	Theory class focussing on discussion about the history, the important discovery and milestones achieved through the evolution of food processing technology since ancient time to present scenario.	Multiple choice questions, quiz, Class test and students presentation.
2.	Knowledge of the structure, composition,	Diagrammatic representation of the structures and discussion on the	Multiple choice questions, match

	nutritional quality and physicochemical changes that can take process during processing of food cereals and millets, pulses, fruits and vegetables and fats and oils, refining of oils	composition, types and processing of cereals and millets, pulses, oilseeds and fruits and vegetables, videos showing gelatinization and retrogradation process, refining process of oils	the following, students presentation, quiz, class test focusing on short notes and definitions.
3.	Knowledge of the structure and composition of animal foods, post mortem changes, nutritive value and processing methods used	Theory classes and discussion on animal foods. Display of pictures or videos on meat, fish, egg and milk processing.	Class tests, assignments, quiz, student presentations

\* Assessment tasks listed here are indicative and may vary.

### **CC FT 102: PRINCIPLES OF FOOD SCIENCE (CREDITS: THEORY-4, PRACTICAL-2)**

#### **COURSE OBJECTIVES**

- To impart basic concepts of food science, food sanitation and food dispersion.
- To introduce the concept of sensory science and types of packaging materials.

#### **COURSE LEARNING OUTCOMES**

Understand the basic concepts of

- Food science, food sanitation and food dispersion.
- Sensory science and types of packaging materials.

**THEORY:           CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

#### **UNIT I**

##### **Food dispersions**

**14**

- Characteristics, sols, gels, pectin gels, colloidal sols, stabilization of colloidal system, syneresis, emulsions, properties of emulsions, formation of emulsion, emulsifying agent, food foams, formation stability and destruction of foam,
- Application of colloidal chemistry to food preparation.

Manay, N.S. and Shadaksharaswamy, M. (1987) *Food-Facts and Principles*. New Delhi: New Age International (P) Ltd. Publishers., Chapter 11, pg no-145-149

## UNIT II

### Sensory evaluation of food

5

- Objectives, type of food panels, characteristics of panel member, layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duo-trio test, triangle test, hedonic scale.

Ranganna, S.(1986). Chapter 17, pp. 594-645

## UNIT III

### Growth of microorganisms in foods

6

- Food as a substrate for microorganism, factors affecting growth of microbes : pH, water activity, O-R potential, nutrient contents, inhibitory substance and biological structure.

Frazier, W.C. and Westhoff, D.C.(2004). *Food Microbiology*.New Delh, Chapter 1, pp. 3-15

## UNIT IV

### Hurdle technology

7

- Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology.

<https://www.crcpress.com/Handbook-of-Food-Preservation/Rahman/p/book/9781574446067>

## UNIT V

### Minimal processing

7

- Minimal processing of foods with thermal methods and non thermal methods-safety criteria in minimally processed foods-Minimal processing in practice-fruits and vegetables-seafood-effect on quality-Future developments

<https://www.crcpress.com/Handbook-of-Food-Preservation/Rahman/p/book/9781574446067>

## UNIT VI

### Ohmic heating and High Pressure processing

6

- Principles, equipment and processing, effect on food.

Potter NH.(1998). *Food Science*, CBS Publication, New Delhi. Chapter 11, pp. 245-263

## UNIT VII

### Water disposal and sanitation

5

- Waste water, hardness of water, break point chlorination, physical and chemical of impurities, BOD, COD, waste water treatment, milk plant sanitation, CIP system, sanitizers used in food industry.

Potter NH.(1998). *Food Science*, CBS Publication, New Delhi. Chapter 22, pp. 514-526

## UNIT VIII

### Packaging

10

- Objectives of packaging, flexible packaging, properties of the following packaging materials-low density polyethylene, high density polyethylene, polypropylene ,polyvinyl chloride, polyvinylidene chloride, ethylene vinyl alcohol, polystyrene, polyethylene

terephthalate, nylon, ethylene vinyl acetate, ethylene acrylic acid, ethylene methacrylic acid, ionomers.

Coles, R., McDowell, D. and Kirwan, M.J. (2003). *Food Packaging Technology*. Chapter 7, pp. 174-207

Potter NH.(1998). *Food Science*, CBS Publication, New Delhi. Chapter 21, pp. 478-512

<b>PRACTICAL</b>	<b>CONTENT</b>	<b>DURATION: 60 HRS (CREDITS 2)</b>
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- Estimation of reducing sugar by Fehling's procedure
- Estimation of salt content in brine and butter
- Preparation of brix solution and checking by hand refractometer
- Application of colloidal chemistry to food preparation
- Demonstration of the Soxhlet method for determination of fat content
- Determination of acidity of water
- Determination of alkalinity/ hardness of water
- Demonstration of the Kjeldahl's method for estimation of protein content
- Determination of BOD/COD of waste water

#### **COMPULSORY READINGS**

- Coles, R., McDowell, D. and Kirwan, M.J. (2003). *Food Packaging Technology*. CRC Press, 2003
- De, S. (1980). *Outlines of Dairy Technology*. Oxford Publishers.
- Deman, J.M. (1990). *Principles of Food Chemistry*, II ed. Van Nostrand Reinhold, NY.
- Frazier, W.C. and Westhoff, D.C.(2004). *Food Microbiology*. New Delhi: TMH Publication
- Manay NS and Shadaksharaswamy M, *Food-Facts and Principles*, New Age International (P) Ltd. Publishers, New Delhi, 1987
- Meyer LH.(1987). *Food Chemistry*, CBS Publication, New Delhi.
- Potter NH.(1998). *Food Science*, CBS Publication, New Delhi.
- Ranganna, S.(1986). *Handbook of Analysis and Quality Control for Fruits and Vegetable Products*. II ed. TMH Education Pvt. Ltd,

#### **ADDITIONAL RESOURCES**

- Jenkins, W.A. and Harrington, J.P. (1991). *Packaging Foods with Plastics*, Technomic Publishing Company Inc., USA.
- Ramaswamy, H. and Marcott, M. (2006). *Food Processing Principles and Applications*. CRC Press.

#### **TEACHING LEARNING PROCESS**

- Power point presentations
- Experiential learning through demonstrations

#### **ASSESSMENT METHODS**

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments

- End semester exams for theory and practical
- Feedback given to students for improving

### KEYWORDS

- Department of food technology
- colloidal chemistry
- Food microbes
- Hurdle Technology
- Food Packaging
- Minimal processing

### Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	Students will gain knowledge on Food dispersion like sols, gels, pectin gels, colloidal sols, stabilization of colloidal system.	Interactive theory classes and also through power point presentation	Class test focusing on definitions and short questions
	Students will be acquainted on concept of colloidal chemistry and its application in food preparation	Detailed discussion on colloidal chemistry with suitable examples and also showing power point presentations	Class test, quiz and multiple-choice questions
2	Students will learn and understand the concept of sensory evaluation, its objectives, type of food panels, characteristics of panel member, layout of sensory evaluation laboratory, various sensitivity tests.	Discussion and detailed theory lectures on concept and their application	Class test focusing on definitions and long subjective questions
3	Students will understand the concept of Food as a substrate for microorganism and factors affecting growth of microbes.	Discussion and detailed theory lectures on concept and their application	Class test focusing on definitions and long subjective questions
4	Students will learn about Hurdle technology and its effect in fermented foods, shelf stable products, and intermediate moisture foods.	Detailed theory class and interactive session	MCQ's and subjective test.
5	Students will gain knowledge on minimal processing of foods with thermal methods and non-thermal methods-safety criteria in minimally processed foods.	Interactive theory classes and also through power point presentation	Class test, quiz and multiple-choice questions
6	Students will learn concepts of ohmic heating and High Pressure processing their principles, equipment, processing and its effect on food	Interactive theory classes and also through power point presentation	Class test focusing on definitions and long subjective questions
7	Students will have gathered information on waste treatment processes in industries	Interactive session and theory classes	Class test and MCQ's and subjective test.



8	Students will have gathered information on Food Packaging, flexible packaging, properties of the packaging materials-low density polyethylene, high density polyethylene, polypropylene ,polyvinyl chloride.	Discussion and detailed theory lectures on concept and their application	Class test focusing on definitions and long subjective questions
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\* **Assessment tasks listed here are indicative and may vary.**

**CC FT 201: TECHNOLOGY OF FOOD PRESERVATION  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- Role of biological agents (microorganisms) in preservation of foods.
- To learn science behind various preservation/processing technologies.
- Technological application of concepts on conventional Indian foods.

**COURSE LEARNING OUTCOMES**

- Understand the importance of microorganisms in food preservation.
- Understanding of the concept of different processing and preservation technologies
- Important application of various preservation methods in food industries.

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Food Microbiology**

**10**

- Principles of Food Preservation, microorganisms associated with foods- bacteria, yeast and mold, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of micro-organisms. Classification of food based on pH, Food infection, food intoxication, definition of shelf life, perishable foods, semi perishable foods, shelf stable foods.

Banwart, G. (2012). *Basic Food Microbiology*. Springer Science & Business Media. Chapter 3, 4  
 Garbutt, John. (1997). *Essentials of Food Microbiology*, Arnold, London. Chapter 2,3,6,9  
 Frazier, W.C. & Westhoff, D.C. *Food Microbiology*. TMH Publication, New Delhi, 2004. Chapter 1, 5

**UNIT II**

**Food Preservation by Low temperature**

**12**

- Freezing and Refrigeration: Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food.

Potter, N. N., & Hotchkiss, J. H. (2012). *Food Science*. Springer Science & Business Media, Chapter 9

### UNIT III

#### Food Preservation by high temperature

9

- Thermal Processing- Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and blanching.

Fellows, P. J. (2009). *Food Processing Technology: Principles and Practice*. Elsevier. Chapter 10, 11,12

### UNIT IV

#### Food Preservation by Moisture control

20

- Drying and Dehydration - Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry.
- Evaporation – Definition, factors affecting evaporation, names of evaporators used in food industry, evaporation equipment's- Batch/Pan evaporator ,rising film evaporator, falling film evaporator, natural circulation and forced circulation evaporator, scraped surface evaporator and vacuum pan evaporator ,application of evaporation in food industry

Fellows, P. J. (2009). *Food Processing Technology: Principles and Practice*. Elsevier.

Ch-13. Evaporation; Ch-15. Dehydration

Potter, N. N., & Hotchkiss, J. H. (2012). *Food Science*. Springer Science & Business Media. Chapter 10

Singh, R.P. and Heldman, D.R.(1993).*Introduction to food engineering*2<sup>nd</sup> edition. Academic press. Chapter 8, 12

### UNIT V

#### Food Preservation by Irradiation

9

- Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, concept of cold sterilization

Potter, N. N., & Hotchkiss, J. H. (2012). *Food Science*. Springer Science & Business Media. Chapter 11.

### PRACTICAL

### CONTENT

DURATION: 60 HRS (CREDITS 2)

- Methods of sampling
- Concept of shelf life of different foods.
- To study the concept of Asepsis and Sterilization
- Determination of pH of different foods using pH meter.
- Study quality characteristics of foods preserved by drying/ dehydration/ freezing.
- To perform pasteurization of fluids using different methods
- To perform blanching of different plant foods

### COMPULSORY READING

- Banwart, G. (2012). *Basic Food Microbiology*. Springer Science & Business Media.
- Garbutt, John. (1997). *Essentials of Food Microbiology*, Arnold, London.

- Potter, N. N., & Hotchkiss, J. H. (2012). *Food Science*. Springer Science & Business Media.

### ADDITIONAL RESOURCES

- Fellows, P. J. (2009). *Food Processing Technology: Principles and Practice*. Elsevier.
- Frazier, W.C. & Westhoff, D.C. *Food Microbiology*. TMH Publication, New Delhi, 2004
- Rao, D.G. *Fundamentals of Food Engineering*, PHI Learning Pvt Ltd, New Delhi, 2010

### TEACHING LEARNING PROCESS

- Lectures
- Visit to Industries
- Application of concepts in Traditional Indian Food systems
- Case Studies

### ASSESSMENT METHODS

Short Quiz Exams, Projects, Continuous Evaluation, Examination as per University of Delhi Norms

### KEYWORDS

Food, Preservation, Technology, Micro-organism, Temperature, Evaporation, Freezing, Drying  
**Facilitating the achievement of course learning objectives**

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will be able to understand the microbial dynamics in food matrix and their application in food preservation	Teaching will be done on discussion mode through lectures. Major learning activities will be through extempore discussions and application in and around environment food.	Quiz, project presentation and discussion
2.	Students will be taught to understand basic science behind refrigeration, freezing and freeze drying.	Teaching will be done through lectures and discussion mode. Plant visits will be organized for better understanding of the concept.	Quiz, project presentation and discussion
3.	Basic principles of heat preservation will be taught.	Teaching will be done through lectures and discussion mode.	Quiz, project presentation and discussion
4.	Basic principles of drying and dehydration will be taught.	Teaching will done through lectures and discussion mode.	Quiz, project presentation and discussion
5.	Concept of cold sterilization will be taught. Methods of irradiation techniques will be discussed.	Teaching will done through lectures and discussion mode.	Quiz, project presentation and discussion

\*Assessment tasks listed here are indicative and may vary.

**CC FT 202: FOOD PROCESSING TECHNOLOGY**  
**(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand freezer, dryer types and functioning
- To understand Irradiation Plant layout, E beam and Microwave heating
- To understand the Packaging requirements of food categories, material handling, separation processes and thermal processing.

**COURSE LEARNING OUTCOMES**

- Understand cold preservation, Freezer types and functioning
- Understand Dehydration, Dryer types and functioning
- Understand Irradiation Plant layout, E beam and Microwave heating
- Understand the Packaging requirements of food categories
- Understand the material handling in food industry, conveyor types, separation processes by distillation, extraction, filtration, centrifugation, sieving and sedimentation
- Understand thermal processing and fundamentals of thermal process calculations

**THEORY:           CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Cold preservation and Freezers**

**15**

- Freezing: requirements of refrigerated storage - controlled low temperature, air circulation and humidity, changes in food during refrigerated storage, Refrigeration load, factors determining freezing rate-food composition and non compositional influences, freezer burn
- Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.

Potter, N.H. (1998). *Food Science*. New Delhi: CBS Publication, Chapter-9, pg 163-199

Ramaswamy, H. and Marcott, M. (2006). *Food Processing Principles and Applications*. CRC Press, Chapter-4, pg 187-223.

**UNIT II**

**Dehydration**

**12**

- Changes in food during drying, drying methods and equipments air convection dryer, tray dryer, tunnel dryer, continuous belt dryer, fluidized bed dryer, spray dryer, drum dryer, vacuum dryer, freeze drying, foam mat drying.

Potter, N.H. (1998). *Food Science*. New Delhi: CBS Publication, Chapter-10, pg 200-243

Ramaswamy, H. and Marcott, M. (2006). *Food Processing Principles and Applications*. CRC Press, Chapter-5, pg 233-296.

**UNIT III**

**Food Irradiation and Microwave Heating**

**6**

- Layout of an irradiation plant, E beam, Microwave heating and applications.

Potter, N.H. (1998). *Food Science*. New Delhi: CBS Publication, Chapter-11, pg 245-262

Rao, P.G. (2010). *Fundamentals of Food Engineering*. New Delhi: PHI Learning Pvt Ltd, Chapter- 15, pg 213-226.

#### **UNIT IV**

##### **Packaging of foods**

**6**

- Factors determining the packaging requirements of various foods and brief description of packaging of frozen products, dried products, fats and oils and thermally processed foods
- Paine, F.A. and Paine, H.Y. (1992). *Handbook of Food Packaging*. New Delhi: Thomson Press India Pvt Ltd, Chapter 9-12, pg 248-334.

#### **UNIT V**

##### **Material handling and Separation processes**

**15**

- Elementary concept of material handling in food industry, equipment and functioning of belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor.
  - Distillation principles and methods: steam, batch, continuous distillation with rectification and stripping.
  - Extraction : Hildebrandt, Bollman, SCF extraction Filtration : Plate and frame , pressure leaf ,continuous rotary vacuum ,batch and continuous filtration
  - Centrifugation: Tubular, disc bowl and basket centrifuge
  - Sieving: stationary and vibratory sieving
  - Sedimentation : continuous thickner,
- Rao, D.G. (2010). *Fundamentals of Food Engineering*. New Delhi: PHI Learning Pvt Ltd, Chapter-19, pg 343-361, Chapter-20, pg 364-387, Chapter-23, pg 428-3453, Chapter-25, pg 486-494, Chapter-26, pg 497-517,

#### **UNIT VI**

##### **Thermal processing**

**6**

- Principles of thermal processing, Thermal resistance of microorganisms, Thermal Death Time, Lethality concept, characterization of heat penetration data, Thermal process Calculations
- Ramaswamy, H. and Marcott, M. (2006). *Food Processing Principles and Applications*. CRC Press, Chapter-3, pg 67-110.

#### **PRACTICAL**

#### **CONTENT**

**DURATION: 60 HRS (CREDITS 2)**

- Comparison of conventional and microwave processing of food
- Preservation of food by the process of freezing
- Drying of food using Tray dryer/other dryers
- Preservation of food by canning (Fruit/Vegetable/meat)
- Cut-out analysis of canned food
- Osmotic dehydration
- Minimal Processing
- Testing of Packaging material

## COMPULSORY READING

- Paine, F.A. and Paine, H.Y. (1992). *Handbook of Food Packaging*. New Delhi: Thomson Press India Pvt Ltd.
- Potter, N.H. (1998). *Food Science*. New Delhi: CBS Publication
- Ramaswamy, H. and Marcott, M. (2006). *Food Processing Principles and Applications*. CRC Press.
- Rao, P.G. (2010). *Fundamentals of Food Engineering*. New Delhi: PHI Learning Pvt Ltd.

## ADDITIONAL RESOURCES

- Desrosier, N.W. and Desrosier, J.N. (1998). *The Technology of Food Preservation*. New Delhi: CBS Publication.
- Toledo, Romeo T. (1999). *Fundamentals of Food Process Engineering*. Aspen Publishers.

## TEACHING LEARNING PROCESS

Lectured based teaching, Power point presentations, Experimental learning through practicals

## ASSESSMENT METHODS

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

## KEYWORDS

Department of Food Technology, Food Processing

### Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will be able to Understand cold preservation ,Freezer types and functioning	Teaching will be done on discussion mode through lectures. Major learning activities will be through extempore discussions and application in and around environment food.	Quiz, project presentation and discussion
2.	Students will be taught to understand Dehydration, Dryer types and functioning.	Teaching will be done through lectures and discussion mode. Plant visits will be organized for better understanding of the concept.	Quiz, project presentation and discussion
3.	Students will be taught to understand Irradiation Plant layout, E beam and Microwave heating	Teaching will be done through lectures and discussion mode.	Quiz, project presentation and discussion
4.	Students will be taught to understand Packaging	Teaching will done through lectures and discussion mode.	Quiz, project presentation and

	requirements of food categories		discussion
5.	Students will be taught to understand material handling, separation processes and thermal processing	Teaching will done through lectures and discussion mode.	Quiz, project presentation and discussion

\*Assessment tasks listed here are indicative and may vary.

**CC FT 301: FOOD AND NUTRITION  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand the relationship between food, nutrition and health.
- To understand digestion, absorption, functions and food sources of various nutrients.
- To appreciate the concept of balanced and healthy diets.
- To know the different methods of cooking and ways to prevent nutrient losses.
- To be able to plan and prepare meals and nutritious dishes for various age groups.
- To be able to assess nutritional status of adults.

**COURSE LEARNING OUTCOMES**

- Appreciate the relationship between food, nutrition and health.
- Explain digestion, absorption, functions and food sources of various nutrients.
- Understand the concept of balanced diets and menu planning.
- Describe different methods of cooking and ways to prevent nutrient losses.
- Plan and prepare meals and nutritious dishes for various age groups.
- Assess nutritional status of adults.

**THEORY: CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Introduction to Food and Nutrition**

**10**

- Basic terms used in study of food and nutrition
- Methods of assessment of nutritional status
- Functions of food-physiological, psychological and social
- Understanding relationship between food, nutrition and health

Chadha, R. and Mathur, P. eds. (2015). *Nutrition: A Lifecycle Approach*. Hyderabad: Orient BlackSwan, Chapter 1

**UNIT II**

**Nutrients**

**30**

- Classification, digestion, absorption, functions, dietary sources, RDA, clinical manifestations of deficiency and excess of the following in brief:
- Energy

- Carbohydrates, lipids and proteins
- Fat soluble vitamins-A, D, E and K
- Water soluble vitamins – thiamine, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C
- Minerals – calcium, iron, iodine, fluorine, copper and zinc

Chadha, R. and Mathur, P. eds. (2015). *Nutrition: A Lifecycle Approach*. Hyderabad: Orient BlackSwan, Chapters 3-11

Byrd-Bredbenner, C., Moe, G., Beshgetoor, D. & Berning, J. (2013). *Wardlaw's Perspectives in Nutrition*, International Edition, 9th edition, New York: McGraw- Hill, Chapters 4-7, 12-15.

### UNIT III

#### **Planning Balanced Meals and Selection of Healthy Foods 12**

- Food Groups
- Concept of Balanced Diets
- Healthy and Fad Diets
- Factors affecting meal planning
- Understanding specific considerations for planning meal for different groups of people.
- Understanding Nutrition labelling on foods, FSSAI regulations, Codex guidelines for health and nutrition claims

Chadha, R. and Mathur, P. eds. (2015). *Nutrition: A Lifecycle Approach*. Hyderabad: Orient BlackSwan, Chapters 1, 14, 15, 17-24.

Seth, V., Singh, K. & Mathur, P. (2018). *Diet Planning Through the Lifecycle Part I: Normal Nutrition- A Practical Manual*. 6th Edition. Delhi: Elite Publishing House.

### UNIT IV

#### **Methods of Cooking and Nutrient Retention 8**

- Dry, moist, frying and microwave cooking - Advantages, disadvantages
- Effect of various methods of cooking on foods and nutrients.
- Preventing nutrient losses

Chadha, R. and Mathur, P. eds. (2015). *Nutrition: A Lifecycle Approach*. Hyderabad: Orient BlackSwan, Chapter 12

#### **PRACTICAL CONTENT DURATION: 60 HRS (CREDITS 2)**

- Identification of food sources for various nutrients using food composition tables.
- Record diet of self, using 24-hour dietary recall.
- Introduction to meal planning, concept of food exchange system.
- Planning of meals for adults of different activity levels for various income groups.
- Planning of nutritious snacks for different age and income groups.
- Preparation of nutritious snacks using various methods of cooking.
- Critical analysis of nutritional labeling of food products.
- Measurement and interpretation of Weight, Height and Waist circumference of adults.

#### **COMPULSORY READINGS:**

- Byrd-Bredbenner, C., Moe, G., Beshgetoor, D. & Berning, J. (2013). *Wardlaw's Perspectives in Nutrition*, International Edition, 9th edition, New York: McGraw- Hill



- Chadha, R. and Mathur, P. eds. (2015). *Nutrition: A Lifecycle Approach*. Hyderabad: Orient Blackswan.
- Longvah, T., Ananthan, R., Bhaskarachary, K. and Venkaiah, K. (2017). *Indian Food Composition Tables*. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research, Department of Health Research, Ministry of Health and Family Welfare, Government of India.
- Seth, V., Singh, K. & Mathur, P. (2018). *Diet Planning Through the Lifecycle Part I: Normal Nutrition- A Practical Manual*. 6th Edition. Delhi: Elite Publishing House.

### **ADDITIONAL RESOURCES**

- Bamji, M.S., Krishnaswamy, K. & Brahmam, G.N.V. (2016). *Textbook of Human Nutrition*, 4<sup>th</sup> edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
- *Codex Guidelines on Nutrition and Health Claims* (CAC/GL 23-1997).
- FSSAI. *Food Safety and Standards Packaging, Labelling and Display Regulations*.
- ICMR. (2010). *Nutrient Requirements and Recommended Dietary Allowances for Indians*. Hyderabad: NIN, ICMR.
- Khanna, K., Gupta, S., Seth, R., Mahna, R. & Rekhi, T. (2004). *The Art and Science of Cooking: A Practical Manual*, Revised Edition. New Delhi: Elite Publishing House Pvt Ltd.
- Raina, U., Kashyap, S., Narula, V., Thomas, S., Suvira, Vir S. & Chopra, S. (2010). *Basic Food Preparation: A Complete Manual*, Fourth Edition. Orient Black Swan Ltd.
- Rekhi, T. and Yadav, H. (2014). *Fundamentals of Food and Nutrition*. New Delhi: Elite Publishing House Pvt Ltd.
- Sethi, P., Lakra, P. (2015). *Aahar Vigyan, Poshan evam Suraksha* (Hindi); First Ed; Delhi: Elite Publishing House (P) Ltd.
- Srilakshmi, B. (2017). *Nutrition Science*. 6<sup>th</sup> edition. Delhi: New Age International Publishers.

### **TEACHING LEARNING PROCESS**

- Power point presentations
- Demonstrations
- Class discussions

### **ASSESSMENT METHODS**

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

### **KEYWORDS**

- Nutrients
- Balanced diets
- Nutrient deficiency
- Nutrition labeling
- Meal planning

### Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Students will be acquainted with the basic terms used in study of food and nutrition; relationship between food, nutrition and health; various functions of food and assessment of nutritional status.	<p>Lecture and power-point presentation of basic terms used in food and nutrition.</p> <p>Discussion on the relationship between food, nutrition and health and on various functions of food.</p> <p>Demonstration of methods of assessment of nutritional status</p>	<p>Assignment focusing on short notes and definitions.</p> <p>Quiz</p> <p>Measurement of height, weight and waist circumference of adults.</p> <p>Recall/record of food intake during last 24 hours</p>
2.	Students will gain knowledge about the functions, dietary sources and clinical manifestations of deficiency/ excess of various macronutrients and micronutrients (vitamins and minerals).	<p>Discussion on functions of nutrients and how deficiency and excess can lead to clinical manifestations.</p> <p>Power point presentation of dietary sources and clinical manifestations of deficiency/ excess of various macronutrients and micronutrients.</p>	<p>Quiz on identification of clinical manifestations of nutrient deficiencies.</p> <p>Class test – objective type</p>
3.	Students will gain knowledge about food groups, concept of balanced diets, difference between healthy and Fad Diets, factors affecting meal planning and understanding specific considerations for planning meal for different groups of people. Student will also be able to understand Nutrition labelling on foods along	<p>Power-point presentation and discussion on food group classification and what constitutes a healthy diet and the various fad diets in practice.</p> <p>Discussion on factors affecting planning of meals for different groups of people.</p> <p>Lecture on food labelling regulations – Indian and International</p> <p>Market survey of food labels</p>	<p>Student presentations/assignment on market survey of food labels and their critical review.</p> <p>Assignment on planning healthy diets/ meals for themselves and others belonging to different age and income groups.</p>

	with regulations.		
4.	Students will be able to understand the various methods of cooking and their effect on foods and the ways of reducing nutrient losses during cooking.	Power point presentation of various methods of cooking and the effect of cooking on nutritional content of foods.  Interactive session with class discussing ways of reducing nutrient losses during cooking at home.	Quiz  Listing of ways how students reduced nutrient losses at home during the last one week.

\*Assessment tasks listed here are indicative and may vary.

**CC FT 302: TECHNOLOGY OF FRUIT VEGETABLE AND PLANTATION CROPS  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand processing and preservation of fruits and vegetables
- To understand maturity indices of fruits and vegetables.
- To understand processing of plantation crops.

**COURSE LEARNING OUTCOMES**

- Understand maturity indices of fruits and vegetables.
- Understand the concept of quality in relation to fruit and vegetable based products.
- Understand the processing and preservation of fruits and vegetables using various techniques.
- Understand processing of plantation crops.

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Introduction**

**6**

- Importance of fruits and vegetable
- History and need of preservation, reasons of spoilage
- Method of preservation (short & long term)
- Fruit Maturity - Definition, methods of maturity determination, maturity indices for selected fruits and vegetables
- Chemical changes during maturation

Thompson, A.K., (2003). *Fruits and vegetables; Harvesting, handling and storage*. Blackwell Publishing. Chapter 2

Somogyi, L.P., Ramaswamy, H.S. and Hui, Y.H. (1996). *Biology, Principles and Applications*. Volume 1. Technomic Publishing Company, Inc. Chapter 1

## UNIT II

### Canning and Bottling of Fruits and Vegetables

12

- Selection of fruits and vegetables
- Process of canning, factors affecting the process- time and temperature
- Containers of packing, lacquering
- Syrups and brines for canning
- Spoilage in canned foods

Girdharilal., Siddappaa, G.S and Tandon, G.L.(1998). *Preservation of fruits & vegetables*. ICAR, New Delhi. Chapter -2,3,4,5,6,7

## UNIT III

### Fruit Beverages

8

- Introduction, reasons of spoilage
- Processing of fruit juices- selection, juice extraction, deaeration, straining, filtration and clarification.
- Preservation of fruit juices- pasteurization, chemically preserved with sugars, freezing, drying, tetra-packing, carbonation.
- Processing of squashes, cordials, nectars, concentrates and powder.
- Packaging of fruit beverages.

Girdharilal., Siddappaa, G.S and Tandon, G.L.(1998). *Preservation of fruits & vegetables*. ICAR, New Delhi. Chapter -8, 9.

## UNIT IV

### Jams, Jellies and Marmalades

7

- Introduction
- Jam: Constituents, selection of fruits, processing & technology.
- Jelly: Essential constituents, Theory of jelly formation, Processing & technology, defects in jelly.
- Marmalade : Types, processing & technology, defects.
- Packaging of jams, jellies and marmalades

Girdharilal., Siddappaa, G.S and Tandon, G.L.(1998). *Preservation of fruits & vegetables*. ICAR, New Delhi. Chapter -11

## UNIT V

### Pickles and Tomato Products

10

- Pickles - Processing and Types, Causes of spoilage in pickling.
- Tomato products -Selection of tomatoes, pulping & processing of tomato juice.
- Tomato puree, paste, ketchup, sauce and soup.
- Packaging of pickles and tomato products

Girdharilal., Siddappaa, G.S and Tandon, G.L.(1998). *Preservation of fruits & vegetables*. ICAR, New Delhi. Chapter -13, 14.

## UNIT VI

### Dehydration of Fruits and Vegetables

6

- Sun drying & mechanical dehydration
- Process variation for fruits and vegetables

Girdharilal., Siddappaa, G.S and Tandon, G.L.(1998). *Preservation of fruits & vegetables*. ICAR, New Delhi. Chapter -16.

## **UNIT VII**

### **Spices**

**6**

- Processing and properties of major and minor spices
- Essential oils & oleoresins

Manay, S. and Shadaksharaswami, M. (2004). *Foods: Facts and Principles*. New Age Publishers. Chapter-20.

## **UNIT VIII**

### **Tea, Coffee and Cocoa**

**5**

- Processing, Variety and Products.

Manay, S. and Shadaksharaswami, M. (2004). *Foods: Facts and Principles*. New Age Publishers. Chapter-12.

## **PRACTICAL**

## **CONTENT**

**DURATION: 60 HRS (CREDITS 2)**

- Estimation of total soluble solids (TSS), pH, acidity and brix: acidity ratio of products.
- Estimation of ascorbic acid and effect of heat treatment on it.
- To study the steps of can making process.
- Preparation and evaluation of pectin products.
- Preparation and evaluation of tomato products.
- Dehydration and Rehydration of fruits and vegetables.
- Extraction and estimation of polyphenol content in tea and coffee.
- Adulteration of spices.

## **COMPULSORY READINGS**

- Girdharilal., Siddappaa, G.S and Tandon, G.L.(1998). *Preservation of fruits & vegetables*. ICAR, New Delhi.
- Thompson, A.K., (2003). *Fruits and vegetables; Harvesting, handling and storage*. Blackwell Publishing.

## **ADDITIONAL RESOURCES**

- Cruse, W.B. (2004). *Commercial Unit and Vegetable Products*. W.V. Special Indian Edition. Agrobios India.
- Manay, S. and Shadaksharaswami, M. (2004). *Foods: Facts and Principles*. New Age Publishers.
- Ranganna S.(1986). *Handbook of analysis and quality control for fruits and vegetable products*. Tata Mc Graw-Hill publishing company limited, Second edition.
- Srivastava, R.P. and Kumar, S. (2006). *Fruits and Vegetables Preservation- Principles and Practices*. 3rd Ed. International Book Distributing Co.
- Somogyi, L.P., Ramaswamy, H.S. and Hui, Y.H. (1996). *Biology, Principles and Applications*. Volume 1. Technomic Publishing Company, Inc.

## TEACHING LEARNING PROCESS

- Lecture methods
- Power point presentations
- Demonstrations
- Experiential learning through practical

## ASSESSMENT METHODS

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

## KEYWORDS

- Department of Food Technology
- Fruits
- Vegetables
- Plantation crops
- Pectin products

### Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcomes	Teaching and Learning activities	Assessment tasks
1	Students will have a broad perspective of maturity indices and preservation of fruits and vegetables.	Discussion on need of preservation and reasons of spoilage of fruits and vegetable. Practical based teaching on methods of maturity determination and maturity indices for selected fruits and vegetables.	Quiz, match the following, identification of fruit maturity through photographs
2	Students will have gathered detailed information on canning and bottling of fruits and vegetables	Flow chart based detailed discussion on process of canning. Theory based lectures on spoilage in canned foods	Multiple choice questions and student presentations
3	Students will gain knowledge on the processing and preservation of fruit beverages.	Detailed discussion on steps involved in processing and preservation of fruit juices, squashes, cordials, nectars, concentrates and powder.	Class tests focusing on short notes and definitions
4	Students will have acquired in-depth knowledge of the essential constituents and processing of Jams, jellies and marmalade.	Group discussions on constituents, types and processing of jam, jellies and marmalade. Packaging of jams, jellies and marmalades will also be taken in to account.	Assignments and student presentations

5	Students will be able to understand the processing and preservation of fruits and vegetables	Interactive lectures on pickling as a method of preservation of fruits and vegetables. Practical example based teaching on the utilization of tomatoes for preparation of various products.	Class test focusing on short notes and definitions.
6	Student will be acquainted with the knowledge of dehydration as a processing technique	Theory classes focusing on different types of dehydration techniques used for fruits and vegetables. Discussion on process variations will also be taken in to account.	Quiz, class presentation and working model based questions.
7	Students will be acquainted with processing of spices	Interactive lectures on processing and proper use of spices	Quiz and Multiple choice question
8	Students will have acquired in-depth knowledge of the processing of tea, coffee and cocoa	Theory lectures on products and flow chart based detailed discussion on processing of tea, coffee and cocoa	Multiple choice questions and student presentations

\*Assessment tasks listed here are indicative and may vary.

### **CC FT 303: TECHNOLOGY OF DAIRY AND SEA FOOD (CREDITS: THEORY-4, PRACTICAL-2)**

#### **COURSE OBJECTIVES**

- To understand fish preservation and value added fish
- To understand the properties and composition of milk, milk processing, milk products and working of a few dairy equipments.

#### **COURSE LEARNING OUTCOMES**

- Understand the importance of dairy and fishery industry, the techniques that can be used for preservation of fish and manufacturing of various value added fish products.
- Understand the various properties and composition of milk and the technology of manufacturing of various products like butter, ghee, flavored milk, yoghurt, dahi, shrikhand, ice cream, cheese, channa, paneer, condensed milk and milk powder.
- Understand market milk industry stages of milk processing and working of a few dairy equipments

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

#### **UNIT I**

##### **Introduction, Chilling and Freezing of fish**

**5**

- Status of fishery industry in India. Relationship between chilling and storage life, MAP, general aspects of freezing, freezing systems (air blast freezing, plate or contact freezing)

spray or immersion freezing, freezing on board, onshore processing, changes in quality in chilled and frozen storage, thawing.

Sen, D.P. (2005). *Advances in Fish Processing Technology*. Allied Publishers Pvt.Limited. Chapter 16 Page no 532-557

Hall, G.M. (1992). *Fish Processing Technology*. NY: VCH Publishers. Chapter 4 Page no 93-117.

## **UNIT II**

### **Fish Curing, Smoking and Canning**

**14**

- Drying and salting of fish, water activity and shelf-life , salting process, salting methods (brining, pickling, kench curing, gaspe curing), types of salts, dried and
- Salted fish products- pindang, fishwood, dried shrimp. Preservation by smoking, smoke production , smoke components, quality, safety and nutritive value of
- Smoked fish, processing and equipment, pre-smoking processes, smoking process control. Traditional chimney kiln, modern mechanical fish smoking kiln, examples of smoked and dried products. Principles of canning, classification based on pH groupings, effect of heat processing on fish, storage of canned fish, pre-process operations, post process operations, cannery operations for specific canned products.(Tuna, Mackerel, Sardine).

Sen, D.P. (2005). *Advances in Fish Processing Technology*. Allied Publishers Pvt.Limited. Chapter 7 Page no 254-294

Hall, G.M. (1992). *Fish Processing Technology*. NY: VCH Publishers. Chapter 2 Page no 32-72.

## **UNIT III**

### **By-products, fermented fish and concept of other seafoods**

**10**

- Surimi- Introduction, fish muscle proteins, the surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products.
- Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysis (FPH)
- Flowchart of Indigenous products- Fish sauce and Paste
- Crabs, lobsters, prawns, shrimps, shell- fish.

Sen, D.P. (2005). *Advances in Fish Processing Technology*. Allied Publishers Pvt.Limited. Chapter 11 Page no 3892-411

Hall, G.M. (1992). *Fish Processing Technology*. NY: VCH Publishers. Chapter 3 Page no 74-90.

## **UNIT IV**

### **Physical properties of milk**

**4**

- Color, taste, pH and buffering capacity, refractive index, viscosity, surface tension, freezing, boiling point, specific heat, OR, electrical conductivity.

Sukumar, D. (2007). *Outlines of dairy technology*. Chapter 1, 1-90



## UNIT V

### Lactose, Milk fat, protein and enzymes

13

- Lactose (alpha and beta forms and their differences), Significances of lactose in dairy industry. Milk fat composition and structure, factors affecting melting point, boiling point, solubility and Refractive Index, fat constants (saponification value, iodine value, RM value, Polenske value, peroxide value).
- Chemical reactions of fat (hydrolysis, auto-oxidation), condition favouring auto-oxidation, prevention, measurement of auto-oxidation.

Sukumar, D. (2007). *Outlines of dairy technology*. Chapter 1, 1-90

### Protein and Enzymes

- General structure, amphoteric nature, difference between casein and serum protein, different types of casein (acid and rennet), uses of casein, fractionation of protein.
- Enzymes- catalase, alkaline phosphatase, lipases and proteases

Sukumar, D. (2007). *Outlines of dairy technology*. . Chapter 1, 1-90

## UNIT VI

### Market milk industry, milk plant equipments and milk products

14

- Systems of collection of milk
- Reception, Platform testing Various stages of processing: Filtration, Clarification, Homogenization, Pasteurization
- Description and working of clarifier, cream separator, homogenizer and plate heat exchanger.
- Flow diagram of following milk products
- Butter, ghee, flavored milk, yoghurt, dahi, shrikhand, ice-cream, condensed milk, milk powder, channa, paneer, cheese (cheddar).

Sukumar, D. (2007). *Outlines of dairy technology*. Chapter 1, 1-90, Chapter 4, 143, Chapter 6 page no.182, Chapter 7, page no. 224, Chapter 8, page no. 268, Chapter 10, page no. 309

## PRACTICAL

## CONTENT

DURATION: 60 HRS (CREDITS 2)

- To perform platform tests in milk.(Acidity,COB,MBRT,specific gravity,SNF)
- To estimate milk protein by Folin method.
- To estimate milk fat by Gerber method.
- Preparation of flavoured milk/. Pasteurization of milk
- To prepare casein and calculate its yield.
- Quality evaluation of fish/prawn.
- Subjective evaluation of Fresh Fish.
- Cut out examination of canned fish.(Sardine,Mackerel,Tuna)
- Fish/Milk product formulation

## COMPULSORY READINGS

- De, Sukumar. (2007). *Outlines of Dairy Technology*. Oxford: Oxford University Press.
- Hall, G.M. (1992). *Fish Processing Technology*. NY: VCH Publishers.

### ADDITIONAL RESOURCES

- Sen, D.P. (2005). *Advances in Fish Processing Technology*. Allied Publishers Pvt.Limited.
- Shahidi, F. and Botta, J.R. (1994). *Seafoods: Chemistry, Processing, Technology and Quality*. London: Blackie Academic & Professional,.
- Webb. and Johnson. (1988). *Fundamentals of Dairy Chemistry*, 3rd ed., New Delhi: CBS Publishers.

### TEACHING LEARNING PROCESS

Lectured based teaching, Power point presentations, Experimental learning through practicals

### ASSESSMENT METHODS

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

### KEYWORDS

Department of Food Technology, Dairy technology, Fish Processing

#### Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	Students will gain knowledge on fishery industry in India. Students will also learn on various freezing systems used for fishery, on board freezing and MAP	Detailed discussion on freezing systems, changes in quality of fish on chilling, freezing and thawing.	Quiz and multiple choice questions
2	Students will be acquainted on smoking, curing and canning of fishes.	Step by step flow chart of smoking, curing and canning. Detail of smoke components, processing, equipment's and fish products by showing power point presentations	Class test

3	Students will acquire in-depth knowledge of fishery by-products, fermented fish and an introduction on concept of seafoods	Theory class on different fishery by-products. Interactive session on surimi and fish mince products. Detailed flowcharts of indigenous fish products	Quiz on identification of sea foods and fish products
4	Students will learn various physical properties of milk	Discussion on melting point, boiling point, solubility and refractive index of milk.	Class test focusing on definitions and short questions
5	Students will understand lactose, milk fat, protein and enzyme	Detailed theory class on lactose and composition of milk including protein and enzymes	Match the following and MCQs
6	Students will have broad perspective on market milk industry, milk plants, equipment's and processing	Practical example based teaching on various processing techniques involved	Student presentations

\* Assessment tasks listed here are indicative and may vary.

### **CC FT 401: TECHNOLOGY OF CEREAL PULSES AND OILSEEDS (CREDITS: THEORY-4, PRACTICAL-2)**

#### **COURSE OBJECTIVES**

- To understand technology of milling of various cereals
- To learn processing of pulses and oilseeds.
- To understand importance & processing of protein rich products.
- To introduce concept of manufacturing Alcoholic beverages.

#### **COURSE LEARNING OUTCOMES**

- Understand basic composition & structure of food grain
- Understand the basics of milling operations
- Learn processing of food grains into value added products
- Manage production, distribution & storage of grains
- Manage by products utilization
- understand the principle of alcoholic beverage preparation

**THEORY: CONTENT****DURATION: 60 HRS (CREDITS 4)****UNIT I****Technology of Wheat and Rice****12**

## Introduction

- Wheat --Types , milling, flour grade, flour treatments (bleaching, maturing), flour for various purposes, Products and By-products.
- Rice – Physicochemical properties, milling (mechanical & solvent extraction), parboiling, ageing of rice, utilization of by products.

Kent N. L, (2007) Technology of Cereals. USA. Woodhead Publication, chapter 6,7,8,9 & 14

**UNIT II****Technology of Corn, Barley, Oats and Coarse grains****20**

- Corn – Milling (wet & dry) , cornflakes, corn flour
- Barley- Milling(pearl barley, barley flakes & flour)
- Oats – Milling ( oatmeal,oatflour&oatflakes )
- Sorghum and millets – Traditional & commercial milling ( dry&wet )
- Rye and triticale—milling (flour),uses

Kent N. L, (2007) Technology of Cereals. USA. Woodhead Publication, chapter 12,13,16 &17

**UNIT III****Technology of Pulses****08**

- Milling of pulses
- Dry milling
- Wet milling
- Improved milling method

Chakraverty A, (1988) Post Harvest Technology of Cereals, Pulses & Oilseeds. Oxford & IBH Publisher. Chapter 13

**UNIT IV****Technology of Oilseeds****12**

- Introduction
- Extraction of oil and refining
- Sources of protein (defatted flour, protein concentrates and isolates)
- Properties and uses
- Protein texturization
- Fibre spinning

Manay, S. and Sharaswamy, M. (1987). *Food Facts and Principles*. Wiley Eastern Publisher, Chapter 14.

**UNIT V****Alcoholic Beverages****08**

- Beer
- Wine
- Distilled Spirits

Manay, S. and Sharaswamy, M. (1987). *Food Facts and Principles*. Wiley Eastern Publisher, Chapter 12.

### COMPULSORY READINGS

- Chakraverty. (1988). *Post Harvest Technology of Cereals, Pulses and Oilseeds*, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd.
- Kent, N.L. (2003). *Technology of Cereal*, 5th Ed. Pergamon Press.

### ADDITIONAL RESOURCES

- Manay, S. and Sharaswamy, M. (1987). *Food Facts and Principles*. Wiley Eastern Limited.
- Marshall. (1994). *Rice Science and Technology*, Wadsworth Ed. New York: Marcel Dekker.

### TEACHING LEARNING PROCESS

- Power-point presentations
- Experiential learning through demonstrations
- Conventional White board Method
- Videos

### ASSESSMENT METHODS

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

### KEYWORDS

- Department of Food Technology
- Technology of Cereals
- Technology of Pulses
- Technology of Oilseeds

### Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	To understand the milling of wheat and rice	Discussion on the types, milling process, flour treatments, product preparation, shelf-life etc	Short & long comprehension based questions
2.	Understand the milling of cereals, various products etc	Discussion on milling of corn, barley, oats, sorghum, triticale & milling, wet & dry milled products, domestic utilization of coarse grains	short notes, flow charts, long questions
3.	Understand the milling of pulses	Discussion on dry & wet process of pulses milling, improved method	Short & long comprehension

		milling	based questions
4.	Understand the concept of oilseed's milling, by-product	Discussion on milling of oilseeds (mechanical & solvent extraction), protein products & texturization	Short & long comprehension based questions
5.	Understand the concept of alcoholic beverage preparation	Discussion on the principle of beer, wine & alcoholic spirit preparation	Short & long & application based questions

\*Assessment tasks listed here are indicative and may vary.

**CC FT 402: FOOD MICROBIOLOGY  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To know the important genera of microorganisms associated with food and their characteristics.
- To understand the role of microbes in fermentation, spoilage and food borne diseases.

**COURSE LEARNING OUTCOMES**

- Understand the important genera of microorganisms associated with food and their characteristics, their growth pattern and parameters.
- Comprehend the role of the microorganisms in spoilage of foods and methods of their control.
- Knowledge about the beneficial role of microorganisms and different types of fermented foods.
- Identify the role of microorganisms in food borne diseases and control measures
- Understand the laboratory techniques to detect, quantify, and identify microorganisms in foods.

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Introduction to Food Microbiology**

**6**

- History and Development of Food Microbiology
- Definition and Scope of food microbiology
- Inter-relationship of microbiology with other sciences

**UNIT II**

**Characteristics of Microorganisms in Food**

**10**

- Types of microorganisms associated with food, their morphology and characteristics ,Significance of spores in food microbiology
- Microbial Growth in Food -Bacterial growth curve and factors affecting the growth of micro organisms in food

**UNIT III**

**Microbial Food Spoilage and Food Preservation**

**16**

- Sources of Microorganisms in foods, some important food spoilage microorganisms

- Spoilage of Specific Food Groups- milk and dairy products, meat, poultry and seafood, cereal and cereal products, fruits and vegetables and canned products
- Control of Microorganisms in Foods -Principles and methods of preservation
- Physical Methods of Food Preservation- Dehydration, Freezing, Cold Storage, Heat Treatment ,Irradiation, Biopreservatives esp. Bacteriocins
- Thermobacteriology- Introduction ,TDT CURVE, D,Z,F values and 12D concept
- Introduction to Hurdle concept and Non Thermal methods- Pulsed Electric Field, High Hydrostatic Pressure, emerging technologies

#### **UNIT IV**

##### **Food Fermentations**

**10**

- Fermentation –definition and types
- Microorganisms used in food fermentations
- Dairy Fermentations-starter cultures and their types , concept of probiotics
- Fermented Foods-types, methods of manufacture for vinegar, sauerkraut, tempeh, miso , soya sauce, yoghurt, beer, wine and traditional Indian foods

#### **UNIT V**

##### **Food borne Diseases**

**8**

- Types – food borne infections, food borne intoxications and toxiinfections
- Origin and symptoms of common food borne diseases and their preventive measures
- Recent outbreaks and emergence of pathogens

#### **UNIT VI**

##### **Cultivation of Micro-organisms**

**10**

- Pure culture technique
- Methods of isolation and cultivation
- Enumeration of microorganisms- Standard Plate Count (conventional and automated), Agar droplet, Direct Microscopic Count, Direct Epi florescent Filtration Technique
- Rapid Methods of Detection of microorganisms

#### **PRACTICAL**

#### **CONTENT**

**DURATION: 60 HRS (CREDITS 2)**

- Introduction to the Basic Microbiology Laboratory Practises and Equipments
- Functioning and use of compound microscope
- Cleaning and sterilization of glassware
- Preparation and sterilization of nutrient broth
- Cultivation and sub-culturing of microbes
- Preparation of slant, stab and plates using nutrient agar
- Morphological study of bacteria and fungi using permanent slides
- Simple staining
- Gram's staining
- Standard Plate Count Method

## COMPULSORY READINGS

- Frazier, William.C. and Westhoff, Dennis, C. (2004) *Food Microbiology*. New Delhi: Tata McGraw-Hill Education.
- Garbutt, J. (1997).*Essentials of Food Microbiology*.London: Arnold.
- Ray, B. andBhunia, A. (2013) *Fundamental Food Microbiology* ,5th Edition. US:CRC Press.

## ADDITIONAL RESOURCES

- Banwart, G.(1989).*Basic Food Microbiology*. US: Springer.
- Jay, James. M. (2000) *Modern Food Microbiology*. New Delhi:CBS Publication.
- Pelczar, M.J., Chan, E.C.S and Krieg, Noel, R. (1993). *Microbiology*, 5th Edition., New Delhi: Tata McGraw-Hill Education.

## TEACHING LEARNING PROCESS

- Active learning method via. face to face interaction
- Use of ICT tools
- Hands on practical experience
- Team and group work
- Practice and research

## ASSESSMENT METHODS

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

## KEYWORDS

- Department of Food Technology
- Food Microbiology
- Microbiology
- Food
- Microorganisms
- Fermentation

### Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcomes	Teaching and Learning activities	Assessment tasks
1	Students will be acquainted with historical developments and scope of food microbiology	<b>Introduction to Food Microbiology</b> <ul style="list-style-type: none"><li>• History and Development of Food Microbiology</li><li>• Definition and Scope of food microbiology</li><li>• Inter-relationship of microbiology with other sciences</li></ul>	Quiz, Match the following, identification of food scientists through photographs
2	Students will be aware of the	<b>Characteristics of Microorganisms in Food</b> <ul style="list-style-type: none"><li>• Types of microorganisms associated with food,</li></ul>	Multiple choice questions and



	important genera of microorganisms associated with food and their characteristics.	<p>their morphology and structure</p> <ul style="list-style-type: none"> <li>• Significance of spores in food microbiology</li> </ul>	presentations ,Diagrammatic representations of structure of microorganisms
3	Students will have gathered detailed information on the role of various factors on growth and response of microorganisms in foods.	<p><b>Microbial Growth in Food</b></p> <ul style="list-style-type: none"> <li>• Bacterial growth curve and microbial growth in food</li> <li>• Factors affecting the growth of microorganisms in food</li> </ul>	Class tests focusing on short notes.
4	Students will have acquired in-depth knowledge of the important food spoilage microorganisms and spoilage of specific food groups	<p><b>Microbial Food Spoilage</b></p> <ul style="list-style-type: none"> <li>• Sources of Microorganisms in foods</li> <li>• Some important food spoilage microorganisms</li> <li>• Spoilage of specific food groups- Milk and dairy products, Meat, poultry and seafood, Cereal and cereal products, Fruits and vegetables and Canned products</li> </ul>	Assignments
5	Students will have gained knowledge on the beneficial role of microorganisms in fermented foods and in food processing.	<p><b>Food Fermentations</b></p> <ul style="list-style-type: none"> <li>• Fermentation –definition and types</li> <li>• Microorganisms used in food fermentations</li> <li>• Dairy Fermentations-starter cultures and their types , concept of probiotics, Fermented Foods-types, methods of manufacture for vinegar, sauerkraut, tempeh, miso , soya sauce ,beer,wine and traditional indian foods</li> </ul>	Student presentations, Quiz, Match the following
6	Students will be acquainted with harmful role of microorganisms in food as pathogens	<p><b>Food borne Diseases</b></p> <ul style="list-style-type: none"> <li>• Types – food borne infections, food borne intoxications and toxiinfections</li> <li>• Common and Recent Examples</li> </ul>	Class tests focusing on short notes.
7	Students will be able to Utilize laboratory techniques to detect, quantify, and identify	<p><b>Cultivation of Micro-organisms</b></p> <ul style="list-style-type: none"> <li>• Pure culture technique</li> <li>• Methods of isolation and cultivation</li> <li>• Enumeration of microorganisms- Standard Plate Count (conventional and automated), Agar droplet, Direct Microscopic Count,</li> </ul>	Student presentations, Quiz, MCQs

	microorganisms in foods.	Direct Epi florescent Filtration Technique,	
8	Students will be able to identify ways to control microorganisms in foods.	<b>Control of Microorganisms in Foods</b> <ul style="list-style-type: none"> <li>• Principles and methods of preservation</li> <li>• Physical Methods of Food Preservation- Dehydration, Freezing, Cool Storage, Heat Treatment (esp.thermobacteriology), Irradiation,</li> <li>• Biopreservatives</li> <li>• Introduction to Hurdle concept and Non Thermal methods- Pulsed Electric Field, High Hydrostatic Pressure, Irradiation ,Oscillating Magnetic Fields, Microwaves.</li> </ul>	Multiple choice questions and student presentations
9	Students will be able to understand recent trends in food microbiology	<b>Trends in Food Microbiology</b> <ul style="list-style-type: none"> <li>• Rapid Methods of Detection</li> <li>• Recent Advances</li> </ul>	Assignments and presentations

\*Assessment tasks listed here are indicative and may vary.

**CC FT 403: TECHNOLOGY OF MEAT POULTRY AND EGGS  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand meat quality and slaughter processes for meat animals and poultry.
- To understand the of concept and methods of processing and preservation of animal foods and by-product utilization.
- To understand egg production practices , egg preservation methods, factors affecting egg quality and measures of egg quality

**COURSE LEARNING OUTCOMES**

- Understand the need and importance of livestock, egg and poultry industry
- Understand the structure, composition and nutritional quality of animal products.
- Understand the of concept and methods of processing and preservation of animal foods.
- Understand the technology behind preparation of various animal food products and by-product utilization
- Understand egg production practices and egg preservation methods
- Understand factors affecting egg quality and measures of egg quality

**UNIT I****Introduction and meat quality****8**

- Livestock and poultry population in India, Development of meat and poultry industry in India and its need in nation's economy, Terminology used for animals and birds based on age, sex, cuts, use.
- Effects of feed breed and stress on production of meat animals and their quality.
- Meat Quality-color, flavor, texture, Water-Holding Capacity (WHC), Emulsification capacity of meat

Lawrie, R. A. (1998). *Lawrie's meat science*. 5<sup>th</sup> ed. England: Woodhead Publishing Ltd. Chapter 1, 2, pg -5-30, chapter 10, pg 280-337

Shai, Barbut. (2005). *Poultry Products Processing*. CRC Press. Chapter 13,14, pg -435- 516.

**UNIT II****Slaughter process and By-products****12**

- Layout of abattoir, Slaughter, Antemortem examination of meat animals, slaughter of buffalo, sheep/ goat, poultry, pig.

Shai, Barbut. (2005). *Poultry Products Processing*. CRC Press. Chapter 4,5, pg-91-135

- A Generic HACCP model for poultry slaughter, post-mortem examination of meat, Grading, Post-mortem changes of meat.

Shai, Barbut. (2005). *Poultry Products Processing*. CRC Press. Chapter 12, pg -385-433

- Importance of by-products utilization, classification and uses of by-products, Manufacture of Natural casings

Shai, Barbut. (2005). *Poultry Products Processing*. CRC Press. Chapter 15, pg 520-530

**UNIT III****Preservation of meat****10**

- Refrigeration and freezing, thermal processing- canning of meat, retort pouch, dehydration, irradiation, meat curing, Sausages-processing, types and defects, Packaging of meat

Lawrie, R. A. (1998). *Lawrie's meat science*. 5<sup>th</sup> ed. England: Woodhead Publishing Ltd. Chapter 7,8,9, pg 189-270

**UNIT IV****Egg Industry and Egg Production Practices****12**

- The egg industry, its techniques of working, general management of poultry farm.

Stadelman, W. J., Newkirk, D., & Newby, L. (2002). *Egg science and technology*. 4<sup>th</sup> ed. New Delhi: CBS Publication. Ch 1, 2, pg 9-35

Parkhurst, C., & Mountney, G. J. (1997). *Poultry meat and egg production*. New Delhi: CBS Publishers. Chapter 1, pg 1-5, ch 7, pg- 97-106, ch 16, pg 266-284

**UNIT V****Preservation of eggs****10**

- Refrigeration and freezing, egg powder manufacture, egg coatings.

Stadelman, W. J., Newkirk, D., & Newby, L. (2002). *Egg science and technology*. 4<sup>th</sup> ed. New Delhi: CBS Publication. Ch 11 pg 217-238, ch 14, pg-285-317

## UNIT VI

### Quality identification of shell eggs

8

- Factors affecting egg quality and measures of egg quality

Stadelman, W. J., Newkirk, D., & Newby, L. (2002). *Egg science and technology*. 4<sup>th</sup> ed. New Delhi: CBS Publication. Ch 3, 4, pg-37-66

### PRACTICAL

### CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Estimation of moisture content of meat
- Cutout analysis of canned meats/retort pouches
- Estimation of protein content of meat
- Analysis of frozen meat/meat emulsion products
- To study shelf-life of eggs by different methods of preservation
- Evaluation of eggs for quality parameters(market eggs,branded eggs)
- To perform freezing of yolk/albumen
- Meat/Egg product formulation

### COMPULSORY READINGS

- Lawrie, R. A. (1998). *Lawrie's meat science*. 5<sup>th</sup> ed. England: Woodhead Publishing Ltd.
- Stadelman, W. J., Newkirk, D., & Newby, L. (2002). *Egg science and technology*. 4<sup>th</sup> ed. New Delhi: CBS Publication.

### ADDITIONAL RESOURCES

- Parkhurst, C., & Mountney, G. J. (1997). *Poultry meat and egg production*. New Delhi: CBS Publishers.
- Pearson, A. M., & Gillett, T. A. (1997). *Processed meats*. 3<sup>rd</sup> ed. New Delhi: CBS Publication.
- Shai, Barbut. (2005). *Poultry Products Processing*. CRC Press.

### TEACHING LEARNING PROCESS

Lecture based teaching, Power point presentations, Experimental learning through practicals

### ASSESSMENT METHODS

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

### KEYWORDS

Department of Food Technology, Meat Technology, Meat Science, Poultry technology, Egg science and Technology

### Facilitating the achievement of course learning objectives

Unit no.	Course outcomes	Teaching and learning activities	Assessment tools
1	Students will be acquainted with the need and importance of livestock, egg and poultry industry. They will get knowledge about meat quality parameters and what are the factors that effect it.	Discussion on the status of livestock and poultry population, development of meat and poultry and its need in nation's economy.  Detailed discussion on meat quality and effects of feed, breed and stress on production of meat animals and their quality.	Quiz, multiple choice questions
2	Students will acquire in-depth knowledge of the slaughter process of poultry and livestock, the importance of antemortem and post-mortem inspection, HACCP for slaughter process and utilization of by-products	Discussion on the layout of abattoir. antemortem and post-mortem examination of meat animals. Diagrammatic representation and discussion on slaughter of buffalo, sheep/ goat, poultry, pig, Generic HACCP model for poultry slaughter. Interaction on importance of by-products utilization, classification and uses of by-products, Manufacture of Natural casings	Fill up questions, true-false, flowcharts, multiple choice questions
3	Students will have acquired detailed knowledge about the various preservation techniques for meat.	Detailed discussion on methods of meat processing and preservation like refrigeration and freezing, thermal processing, dehydration, irradiation, meat curing, Sausages-processing, types and defects, Packaging of meat	Quiz, Student presentations
4	Students will be aware about status, working of egg	Detailed discussion of the importance of egg industry and its techniques of working,	Quiz and multiple choice questions

	industry and management of poultry farm	Theory class on general management of poultry farm.	
5	Students will have gained knowledge about various preservation techniques for eggs	Detailed theory lecture on preservation of egg. Diagrammatic flowchart on egg powder manufacture and discussion egg coatings.	Test, flowcharts, fill ups
6	Students will have in-depth knowledge of egg quality and factors which effect.	Theory lecture on factors affecting egg quality and practical interactive session measures of egg quality	practical test, quiz, multiple choice questions

\* Assessment tasks listed here are indicative and may vary.

**CC FT 501: FOOD ENGINEERING  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand the principle of Unit operation
- To acquaint with fundamentals of food engineering and its process
- To understand the basics of designing of food plant and systems

**COURSE LEARNING OUTCOMES**

- Students would understand and comprehend the principle of unit operations
- Students can understand basics of designing of food plant and storage system
- Students can be familiarized with basic principles of refrigeration, freezing, fluid flow, heat and mass transfer, steam, psychrometrics etc. from food industrial point of
- Students can apply these principles for solving numerical and problems

**THEORY:           CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Introduction**

**4**

- Concept of Unit operation,
- Units and dimensions, Unit conversions, dimensional analysis
- Mass and Energy Balance.
- Related numerical

Singh, R.P. and Heldman, D.R. (1993). *Introduction to food engineering* 2<sup>nd</sup> edition. Academic press, Chapter 1, Pg 1-41

## UNIT II

### **Design of food plant and grinding & mixing unit operation** **8**

- Important considerations for designing of food plants
- Types of layout
- Design and layout of storage godown
- Principle and equipment used in grinding in food industry
- Principle and equipment used in mixing in food industry

Rao, D.G. (2010). *Fundamentals of food engineering*. PHI learning private ltd., Ch 29, Pg 564-582, Ch 24, Pg 454-464, Ch 25, Pg 477-485

Fellows, P. (2000). *Food processing technology*. Woodhead publication, 2nd edition, ch 4, Pg 98-116, Ch 5, Pg 118-132

## UNIT III

### **Fluid Flow in food Processing** **8**

- Liquid Transport systems
- Newton's Law of Viscosity
- Principle of Capillary tube and rotational viscometer
- Properties of Non-Newtonian fluids
- Flow characteristics, Reynolds Number, Bernoulli's Equation
- Concept of Flow Measurement devices
- Related basic numerical

Singh, R.P. and Heldman, D.R. (1993). *Introduction to food engineering* 2<sup>nd</sup> edition. Academic press, Chapter 2, Pg 42- 43, 48-66, 82-94

## UNIT IV

### **Refrigeration and Freezing** **8**

- Concept and selection of a refrigerant
- Description of a Refrigeration cycle
- Pressure Enthalpy charts and Tables
- Mathematical expressions useful in analysis of vapour compression refrigeration cycle
- Numerical on VCR system using R -134 a , R-717 including super heating and sub cooling
- Freezing time calculation using Plank equation
- Frozen food storage
- Related basic numerical

Singh, R.P. and Heldman, D.R. (1993). *Introduction to food engineering* 2<sup>nd</sup> edition. Academic press, Ch 7 Pg 259-297, Ch 8 Pg 312-314, 319-325

Singh, R.P. and Heldman, D.R. (2009). *Introduction to food engineering* 4<sup>th</sup> edition. Academic press , Ch 6, Pg 482-487

## UNIT V

### **Heat and Mass Transfer** **14**

- Systems for heating and cooling food products
- Thermal Properties of Food
- Modes of heat transfer

- Application of steady state heat transfer- estimation of conductive heat transfer coefficient, convective heat transfer coefficient, overall heat transfer coefficient and, design of tubular heat exchanger , related basic numerical
- Fick's Law of Diffusion
- Membrane separation systems-Electrodialysis system , Reverse Osmosis, Ultra filtration
- Membrane devices used for RO and UF: Plate and Frame, Tubular, Spiral wound and hollow fiber devices

Singh, R.P. and Heldman, D.R.(1993).*Introduction to food engineering*2<sup>nd</sup> edition. Academic press, Ch 4, Pg 129-183, Ch 11, Pg 374, 385-407

## UNIT VI

### Psychrometrics , Steam, Evaporation and Dehydration

18

- Properties of dry air, water vapour , air vapour mixture
- Psychrometric Chart and its application
- Generation of steam
- Construction and functions of fire tube and water tube boilers
- Thermodynamics of Phase change
- Steam tables
- Boiling point elevation
- Types of evaporators
- Design of single effect evaporators
- Basic Drying Process
- Moisture content on wet basis and dry basis , numerical
- Dehydration systems
- Dehydration system Design
- Numerical

Singh, R.P. and Heldman, D.R. (1993). *Introduction to food engineering*2<sup>nd</sup> edition. Academic press, Ch 10,Pg 353-372, Ch 95-105, Ch 9 Pg 327-343, Ch 12, Pg 415-431

### PRACTICAL

### CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Plant layout design
- Determination of drying characteristics
- Study effect of temperature on viscosity of Newtonian and non Newtonian fluids
- Screen analysis of food sample
- Study of evaporation process
- Freezing time calculation
- Psychrometrics- use and application
- Study of colligative properties

### COMPULSORY READINGS

- Fellows, P. (2009).*Food processing technology*. Woodhead publication, 3rd edition
- Rao, D.G. (2010). *Fundamentals of food engineering*. PHI learning private ltd.
- Singh, R.P. and Heldman, D.R.(1993) (2009) *Introduction to food engineering*2<sup>nd</sup> edition. 4<sup>th</sup> edition Academic press.



### ADDITIONAL RESOURCES

- Earle, R.L. (1983). *Unit Operations in Food Processing*, 2nd edition. Pergamon press.
- Singh, R.P and Heldman DR. (2014). *Introduction to food engineering* 5th edition. Academic press.
- Toledo Romeo T. (1999). *Fundamentals of Food Process Engineering*. Aspen Publishers

### TEACHING LEARNING PROCESS

- Power point presentation
- Demonstration
- Video
- Group discussion

### ASSESSMENT METHODS

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

### KEYWORDS

- Unit operation
- Plant lay out design
- Grinding and mixing
- Evaporation
- Drying
- Heat transfer
- Mass transfer

### Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment task
1	Students would understand and comprehend the principle of unit operations and law of conservation	Practical example based teaching, Theory classes for derivation, , power point presentation	Numerical, derivation, diagrammatic representation of mass and energy balance, flow chart
2	Students can understand basics of designing of food plant and storage system	Diagrammatic representation , flow chart, case studies	Diagrammatic representation, short and long questions
3	Students can be familiarized with basic principles of fluid flow	Numerical, derivation, group discussion, power point presentation	Numerical, derivation, objective and short questions

4	Students can be familiarized with basic principles of refrigeration, freezing from food industrial point of view	Numerical, derivation, mathematical modelling, Diagrammatic representation, power point presentation	Numerical, derivation, flow chart, VCR cycle representation, Diagrammatic representation of refrigerant, short questions
5	Students can be familiarized with basic principles of heat and mass transfer from food industrial point of view	Derivation, numerical, practical example based calculations, video, power point presentation	Derivation, numerical, objective, short and long questions
6	Students will be aware of properties of water vapour mixture and their applications in food industry	Numerical, derivation, Diagrammatic representation, video, discussion, power point presentation, practical example based calculations	Diagrammatic representation, numerical, derivation, definitions, interpretation from chart and graph

\* Assessment tasks listed here are indicative and may vary.

**CC FT 502: FOOD CHEMISTRY-I**  
**(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand the chemistry of foods - composition of food, role of each component and their interaction.
- To understand the functional aspects of food components and to study their role in food processing.

**COURSE LEARNING OUTCOMES**

- Understand and describe the general chemical structures of the major components of foods (water, proteins, carbohydrates, and lipids).
- Give a molecular rationalization for the observed physical properties and reactivity of major food components.
- Provide a theoretical explanation for observed extent and rates of reactions that are common to foods
- Predict how processing conditions are likely to change the reactivity of food components
- To predict how changes in overall composition are likely to change the reactivity of individual food

**THEORY: CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Water**

**12**

- Definition of water in food
- Structure of water and ice
- Types of water
- Sorption phenomenon
- Water activity and packaging
- Water activity and shelf-life

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 1

**UNIT II**

**Lipids**

**12**

- Classification of lipids
- Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point.
- Chemical properties-reichertmeissel value, polenske value, iodine value, peroxide value, saponification value.
- Effect of frying on fats
- Changes in fats and oils- rancidity, lipolysis, flavor reversion
- Auto-oxidation and its prevention
- Technology of edible fats and oils- Refining, Hydrogenation and Interesterification, Fat MimeticS

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 2

**UNIT III**

**Proteins**

**12**

- Protein classification and structure
- Nature of food proteins(plant and animal proteins)
- Properties of proteins (electrophoresis, sedimentation, amphoterism and denaturation,)
- Functional properties of proteins eg. organoleptic, solubility, viscosity ,binding, gelation / texturization , emulsification , foaming.

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 3

**UNIT IV**

**Carbohydrates**

**10**

- Classification(mono, oligo and poly saccharides)
- Structure of important polysaccharides( starch, glycogen, cellulose, pectin, hemicellulose, gums)
- Chemical reactions of carbohydrates –oxidation, reduction , with acid &alkaki
- Modified celluloses and starches

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 4

## UNIT V

### Vitamins

8

- Structure ,Importance and Stability
- Water soluble vitamins
- Fat soluble vitamins

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 9

## UNIT VI

### Flavour

6

- Definition and basic tastes
- Chemical structure and taste
- Description of food flavours , Flavour enhancers

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 7

## PRACTICAL

## CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Preparation of primary and secondary solutions
- Estimation of moisture content
- Determination of gelatinization temperature range (GTR) of different starches and effect of additives on GTR.
- Determination of refractive index and specific gravity of fats and oils.
- Determination of smoke point and percent fat absorption for different fat and oils.
- Determination of percent free fatty acids
- Estimation of saponification value
- Estimation of reducing and non-reducing sugars using potassium ferricyanide method.

## COMPULSORY READINGS

- DeMan, J.M.(1980).*Principles of Food Chemistry*.NewYork: AVI.
- Fennema, Owen R. (1996).*Food Chemistry*. 3rd Ed..NewYork: Marcell Dekker.
- Whitehurst and Law.(2002).*Enzymes in Food Technology*. Canada: CRC Press.

## ADDITIONAL RESOURCES

- Potter,N.N.andHotchkiss,J.H. (1995). *Food Science*, 5th Ed., Chapman & Hall.
- Sehgal, S.(2016). “*A Laboratory Manual of Food Analysis*” ISBN 978-93-84588-84-7. India: IK International.
- Wong, Dominic WS. (1995). *Food Enzymes*.New York: Chapman and Hall.

## TEACHING LEARNING PROCESS

- Power-point presentations
- Experiential learning through demonstrations
- Conventional White board Method
- Videos

## ASSESSMENT METHODS

- As per University of Delhi norms
- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

### KEYWORDS

- Department of Food Technology
- Food Chemistry
- Product Formulation
- Composition of food

### Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Understand and describe the general chemical structures of the major components of foods— Water	Discussion on structure of water, steam & ice. Relationship of water & packaging, water vs shelf-life water activity etc	Multiple choice questions, short notes, application on product development
2.	Understand and describe the general chemical structures of the major components of foods— lipids	Discussion on various types of lipids, fatty acids, rancidity, control of rancidity etc	Multiple choice questions, short notes, application on product development
3.	Understand and describe the general chemical structures of the major components of foods— protein	Discussion on structure of amino acids & proteins, classification & properties (functional)	Short & long tests, application based test & projects
4.	Understand and describe the general chemical structures of the major components of foods— carbohydrate	Discussion on structure of carbohydrates, properties, types & role during cooking/processing	Short & long tests, application based test & projects
5.	Understand and describe the general chemical structures of the major components of foods— vitamins	Discussion on types, structure & properties of water soluble & insoluble vitamins of food	Short & long tests, application based tests
6.	Understand and describe the concept & unit structure of flavour producing substances	Discussion on types, chemical compounds responsible for different flavours, their interaction with other components etc	Short & long & application based questions.

\*Assessment tasks listed here are indicative and may vary.



- Drying and dehydration
- Irradiation
- Freezing
- Canning

Desrosier N W & Desrosier J N. (1977). *The technology of food preservation*. AVI Publisher. Chapter-4<sup>th</sup> & 5<sup>th</sup>

## UNIT VI

### New product development

8

- Definition
- Importance
- Need of product development
- Steps of product development-
- Product development tools
- Reasons for failure

## PRACTICAL

## CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Estimation of total ash
- Estimation of minerals -demo
- Determination of thermal inactivation time of enzymes in fruits and vegetables.
- Estimation of iodine value
- Estimation of peroxide value
- Determination of carotenoids w.r.t flour pigments.
- Extend of non-enzymatic browning by extraction methods.
- Introduction of the concept of new product

## COMPULSORY READINGS

- Desrosier, Norman W. and Desrosier, James.N. (1977). *The technology of food preservation*, 4th Ed. Westport, Conn.: AVI Pub. Co.
- Fennema, Owen. R. (1996). *Food Chemistry*, 3rd Ed., New York: Marcell Dekker.

## ADDITIONAL RESOURCES

- deMan. & John, M. (1999). *Principles of Food Chemistry*.,3rd Ed.. Springer.
- Sehgal, S.(2016) "*A Laboratory Manual of Food Analysis*" ISBN 978-93-84588-84-7. India:IK International.

## TEACHING LEARNING PROCESS

- Power-point presentations
- Experiential learning through demonstrations
- Conventional White board Method
- Videos

## ASSESSMENT METHODS

- As per University of Delhi norms

- Continuous evaluation of practicals
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving

### KEYWORDS

- Department of Food Technology
- Food Chemistry
- Product Formulation
- Shelf-life

### Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Understand and describe the types of minerals present in food & their behaviour	Discussion on the major & minor minerals present in food, their source, effect & deficiency disorders	Multiple choice questions, short notes
2.	Understand and describe the reasons for different colours of food, chemical structures of the major compounds responsible for colour	Discussion on various types of pigments, their structures, stability during processing etc	Multiple choice questions, short notes, application on product development
3.	Understand and describe the browning phenomenon	Discussion on types of browning, role on product's quality, control on browning etc	Short & long tests, application based test & projects
4.	Understand and describe about enzymes & its effect on quality of food	Discussion on enzyme action, types, effect on processing & application	Short & long tests, application based test
5.	Understand and describe the changes in quality of food during processing	Discussion on physico-chemical & nutritional changes occurring in food during standard processing	Short & long tests, application based tests
6.	Understand the concept of product development	Discussion on need, objectives & reasons of failure of NPD. Detailed steps of NPD, tools etc	Short & long & application based questions.

**\*Assessment tasks listed here are indicative and may vary.**



**CC FT 602: FOOD QUALITY AND SENSORY EVALUATION**  
**(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To provide an insight of basic tastes and derived tastes in food.
- To understand basic sensory quality attributes of raw and processed foods.
- To understand the objective and subjective methods of sensory evaluation and their application in industry.

**COURSE LEARNING OUTCOMES**

- Understand and apply the principles of sensory science in product development and optimization, studies of alternative processing, packaging and storage, as well as relating sensory to physical properties of food.
- Able to analyze color, flavor, texture and other sensory characteristics of food for quality assurance.
- Able to measure consumer perception and acceptance of food products.

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Introduction to Sensory Quality Attributes of Food**

**6**

Appearance, flavour, textural factors and additional quality factors

Rao, E. S. (2013). *Food Quality Evaluation* (1st ed.). New Delhi: Variety Book Publishers, Chapter 1,2 pg. 3-31

**UNIT II**

**Gustation**

**8**

- Introduction and importance of gustation
- Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands
- Mechanism of taste perception
- Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami
- Factors affecting taste quality, reaction time, taste modification, absolute and recognition threshold
- Recent advances in Taste measurement- Electronic Tongue
- Taste abnormalities

Rao, E. S. (2013). *Food Quality Evaluation* (1st ed.). New Delhi: Variety Book Publishers. Chapter 6 pg. 153-186

**UNIT III**

**Olfaction**

**14**

- Introduction, definition and importance of odour and flavor
- Anatomy of nose, physiology of odour perception
- Mechanism of odour perception
- Theories of odour classification, chemical specificity of odour
- Recent advances in olfaction measurement – Electronic Nose, GC Mass Spectroscopy
- Olfactory abnormalities

## UNIT IV

### Colour

12

- Introduction and importance of colour
- Dimensions of colour and attributes of colour; gloss etc.
- Perception of colour
- Colour Measurement: Munsell colour system, CIE colour system, Hunter colour system, Tintometer
- Colour abnormalities

Rao, E. S. (2013). *Food Quality Evaluation* (I ed.). New Delhi: Variety Book Publishers. Chapter 5 pg. 111- 148

## UNIT V

### Texture

20

- Introduction, definition and importance of texture
- Significance of sound in texture evaluation
- Physiology of Sense of Touch- texture perception, phases of oral processing, receptors involved in texture evaluation.
- Rheology of foods
- Texture classification
- Texture measurement – basic rheological models, forces involved in texture measurement and recent advances in texture evaluation
- Assessment of Texture of different food Products - bread, biscuits/ cookies, dairy - butter, cheese rheology, fruits and vegetables- peas, apples

Rao, E. S. (2013). *Food Quality Evaluation* (I ed.). New Delhi: Variety Book Publishers. Chapter 8, 9, 15, 16, 19 pg. 203-231pg 243-278, pg. 329-345, 357-376, 401- 427

## PRACTICAL

## CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Training of sensory panel.
- To perform recognition tests for basic tastes.
- To perform various Analytical tests
  - Discriminative Tests: Simple and directional Difference tests, Ranking and Rating Tests.
  - Sensitivity Tests: Threshold, /Dilution for basic tastes
  - Descriptive Tests: Category Scaling (structured and unstructured) Quantitative Descriptive Analysis.
- To perform Affective Tests (Preference and Acceptance Tests)
  - Hedonic Scale (verbal, facial)
  - Food Action Scale
- Perform sensory evaluation of any dairy product-market milk/cheese/butter/ice cream
- Analyze flavour defects in milk/ ice-cream/ butter.
- Texture Profile Analysis of any given food product- Biscuits/ cookies/ chips/ fruits.
- Instrumental Evaluation:(if available)
- Textural measurement of various food products using Texture Analyzer
- Colour measurement using Lovibond Tintometer/ Hunter Colour Lab.

- Determine the puncture strength of fruits and vegetables or butter/ margarine using Penetrometer.
- Viscosity measurement of fluids using Brookfield's Viscometer.

Rao, E. S. (2014). *Food Quality Testing and Evaluation: Sensory Tests and Instrumental Techniques*. Variety Book Publishers. New Delhi

### **COMPULSORY READINGS**

- deMan, J. (2007). *Principles of Food Chemistry* (3rd ed.). Springer.
- Meilgard. (1999). *Sensory Evaluation Techniques* (3rd ed.). CRC Press LLC.
- Rao, E. S. (2013). *Food Quality Evaluation* (1st ed.). New Delhi: Variety Book Publishers.

### **ADDITIONAL RESOURCES**

- Gerorge, A. B. (2004). *Fenaroli's Handbook of Flavor Ingredients* (5th ed.). CRC Press
- Harry, T. Lawless. & Barbara, P. Klien. (1991) *Sensory Science Theory and Applications in Food*. New York: Marcel Dekker.
- Morton, I. D. & Macleod, A. J. (1990). *Food Flavours. Part A, B & C*. Elsevier.
- Rao, E. S. (2014). *Food Quality Testing and Evaluation: Sensory Tests and Instrumental Techniques* (1st ed.). New Delhi. Variety Book Publishers.

### **TEACHING LEARNING PROCESS**

- Lecture methods
- Power point presentations
- Demonstrations
- Experiential learning through practicals

### **ASSESSMENT METHODS**

- Tests
- Projects
- Continuous Evaluation
- Examination as per University of Delhi Norms

### **KEYWORDS**

- Department of Food Technology
- Food Quality & Sensory Evaluation
- Quality attributes
- Gustation
- Olafaction
- Colour
- Texture
- Rheology

### Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcomes	Teaching and Learning activities	Assessment tasks
1	Students will be acquainted with sensory quality attributes of food	Discussion on various food quality attributes.	Quiz and Multiple choice questions
2	Students will have acquired in-depth knowledge about importance, physiology and factors affecting taste perception	Theory classes on importance of gustation, chemical dimensions of taste and factors affecting taste quality. Pictorial representation of taste organs.  Application based teaching on taste measurement.	Multiple choice questions and student presentations Diagrammatic representations of taste organs and taste measurement tool(s)
3	Students will have gathered detailed information on physiology of smell, odor perception and odor measurement	Theory classes on importance of odor and flavor. Illustrative representation of anatomy of nose. Detailed discussion on odor perception and theories of odor classification.  Practical example-based teaching on olfaction measurement.	Student presentations, Diagrammatic representations of nose and odor measurement tool(s). Class tests focusing on short notes and definitions
4	Students will be able to understand importance of colour, its perception and measurement	Theory classes on importance of colour. Group discussion on perception and dimensions of colour. Practical example based teaching on colour measurement.	PowerPoint presentations, Quiz and Multiple choice questions
5	Students will have gained knowledge on texture as a quality attribute, texture measurement and assessment of texture of different food products	Theory classes on importance and significance of texture. Group discussions on physiology of sense of touch and classification of texture. Hands-on experience on texture assessment of different food products.	Identification of rheological models and basic forces through photographs/diagrams. Class tests focusing on short notes and definitions

\*Assessment tasks listed here are indicative and may vary.

# DISCIPLINE SPECIFIC ELECTIVES

## DSE FT 01: FOOD SAFETY (CREDITS: THEORY-4, PRACTICAL-2)

### COURSE OBJECTIVES

- To understand the concept of safe food and types of hazards associated with food.
- To control the potential threats to safety of food.
- To familiarize with the Good Hygienic Practices, Food Safety Management Systems and Food Regulations.

### COURSE LEARNING OUTCOMES

- Understand the concept of food safety ,types of hazards and their control measures
- Identify and prevent potential sources of food contamination
- Comprehend the need of hygiene and sanitation for ensuring food safety
- Knowledge of Food Safety Management tools
- Understand National and International Food Safety Laws and Regulations
- Practical knowledge to detect and quantify microorganisms from various routes of contamination of food

### THEORY: CONTENT

**DURATION: 60 HRS (CREDITS 4)**

#### UNIT I

##### **Introduction to Food Safety**

**6**

- Definition of safe food
- Types of hazards
- Factors affecting Food Safety
- Importance of Safe Foods
- Role of communication and training in food safety

Mathur, P. (2018). Food Safety and Quality Control. Hyderabad: Orient BlackSwan Pvt. Ltd.,

#### UNIT II

##### **Hazards associated with food**

**10**

- Mode of entry of hazards in food
- Physical hazards –common examples and control measures
- Chemical hazards (naturally occurring ,environmental and intentionally added ), Packaging material as a threat, Impact on health
- Biological hazards ( Food borne pathogens: bacteria, viruses and eukaryotes) ,Seafood and Shell fish poisoning, Mycotoxins, Indicator Organisms

Forsythe, S.J. (2010).*The Microbiology of Safe Food* , 2<sup>nd</sup> edition. UK: Willey-Blackwell.

Lawley, R., Curtis L. and Davis,J.(2012) *The Food Safety Hazard Guidebook*. London: RSC

Marriott, Norman G. (1985).Principles of Food Sanitation.New York: AVI.

Mathur, P. (2018). Food Safety and Quality Control. Hyderabad: Orient BlackSwan Pvt. Ltd.

### UNIT III

#### Management of hazards

18

- Need of controlling of critical parameters -Design of food plant , Temperature Danger Zone and Storage of Food , Role of Handler , Personnel Hygiene ,Quality of Water and its analysis,
- Hygiene and Sanitation in Food Service Establishments -Sources of contamination, General Principles of Hygiene, Sanitation and methods of control using physical and chemical agents ,Waste Disposal ,Pest and Rodent Control, Effluent Treatment Plant system

### UNIT IV

#### Food Safety Management Tools

10

- Basic Concept
- Prerequisite programs
- HACCP, ISO series, TQM - components of TQM
- Risk Analysis
- Accreditation and Auditing

### UNIT V

#### Food Laws and Standards

10

- Introduction to Standards, Specifications and limits
- National Food Regulation-FSSA and important regulatory Agencies –FSSAI, BIS ,APEDA
- International regulatory scenario and role of organizations - Codex, WHO,FAO
- ,ICMSF

Mathur, P. (2018). Food Safety and Quality Control. Hyderabad: Orient BlackSwan Pvt. Ltd.,  
Mortimore S.and Wallace C. (1995).HACCP-A Practical Approach. London: Chapman and Hill.

### UNIT VI

#### Trends in Food Safety

6

- New and Emerging Pathogens
- Genetically Modified Foods \ Transgenics, Organic foods and labelling
- Food Frauds
- Newer approaches to food safety

Recent Journal references

### PRACTICAL

### CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Preparation of different types of media (complex, differential and selective)
- Enumeration of aerial microflora using PDA
- Identification of Molds by lactophenol blue staining
- Negative Staining
- Microbiological Examination of food
- Bacteriological Analysis of Water by MPN method
- Assessment of surface sanitation by swab and rinse method
- Assessment of Personal Hygiene

### **COMPULSORY READINGS**

- Forsythe, S.J. (2010). *The Microbiology of Safe Food*, 2<sup>nd</sup> edition. UK: Willey-Blackwell.
- Lawley, R., Curtis L. and Davis, J. (2012) *The Food Safety Hazard Guidebook*. London: RSC.
- Mathur, P. (2018). *Food Safety and Quality Control*. Hyderabad: Orient BlackSwan Pvt. Ltd.,

### **ADDITIONAL RESOURCES**

- Blackburn, C.D.W. and Mc Clure, P.J. (2005). *Food borne pathogens. Hazards, risk analysis & control*. Washington, US: CRC Press.
- De Vries. (1997). *Food Safety and Toxicity*. New York: CRC.
- Marriott, Norman G. (1985). *Principles of Food Sanitation*. New York: AVI.
- Mortimore S. and Wallace C. (1995). *HACCP-A Practical Approach*. London: Chapman and Hill.

### **TEACHING LEARNING PROCESS**

- Active learning method via. face to face interaction
- Use of ICT tools
- Hands on practical experience
- Team and group work
- Practice and research

### **ASSESSMENT METHODS**

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

### **KEYWORDS**

- Department of Food Technology
- Food safety
- Hazards
- HACCP
- FSSAI

### Facilitating the Achievement of Course Learning Objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment task
1	Students will understand the concept of food safety, types of hazards associated with food and its importance	Introduction to Food Safety- Definition of safe food , Types of hazards ,Factors affecting food safety, importance of Safe Foods and role of communication and training in food safety	Quiz, Multiple Choice Questions, Assignments on communicative skills
2	Students will be able to identify the types of hazards and their route of entry into the food chain and also their impact on health	Hazards associated with food ( physical, chemical and biological ),Mode of entry, common examples and their control measures	Class tests focusing on examples of hazards and recent examples in Indian context
3	Students will comprehend the management of various hazards and significance of Good Hygienic Practices	Control of the potential threats to safety of food, Importance of Design of food plant, Temperature Danger Zone, Personnel Hygiene. Role of Hygiene and Sanitation in Food Service Establishments	Student presentations, Quiz, Assignments on the types of sanitizing agents used in the food industry
4	Students will acquire the knowledge of Food Safety Management tools	Managing Food Safety - Prerequisite programs, HACCP, ISO series, TQM ,Risk Analysis, Accreditation and Auditing	Projects based on the case studies from various sectors of food industry.
5	Students will be acquainted with National and International Food Safety Laws and Regulations	Understanding the current National Food Safety Regulation and FSSAI. International regulatory scenario and the role of different agencies	Quiz, Match the following, Identification of various regulatory bodies in different countries
6	Students will acquire practical knowledge to detect and quantify	Hands on teaching on methods used for detection of new and	Multiple choice questions, Practical assessment



	microorganisms from various routes of contamination of food	emerging pathogens class room teaching on the concept of Genetically Modified Foods and introduction of newer approaches to food safety	
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**\*Assessment tasks listed here are indicative and may vary.**

**DSE FT 02: FOOD QUALITY MANAGEMENT  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand the need and importance of quality management in food production chain.
- To understand intentional and non -intentional of food contaminants in the food chain.
- To understand the chemical, technological and toxicological aspects of food additives.

**COURSE LEARNING OUTCOMES**

- Understand, use and apply the knowledge, skills of quality management in food processing.
- Understand and critically evaluate the presence of contaminants in food quality assurance.
- Understand the chemical, technological and toxicological aspects of food additives in food preservation.

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Food Quality Management**

**16**

- Introduction to food quality management – Definition, quality concepts, quality, quality perception, quality attributes
- Concepts of quality management- Objectives, importance and functions of quality control and quality assurance
- Quality in the Agri- food production chain, Techno- managerial approach, food quality relationship and food quality management functions
- Dynamics on the agri- food production chain, core developments in food quality management

Pieterneel A, Luning. & Willem, J. Marcelis. (2009). *Food Quality Management Technological and Managerial principles and practices*. Wageningen. Chapter 1, pg.19-31, Ch 3 pg. 93-139, Ch 9 pg. 391-395

## UNIT II

### Contamination in Food Chain

14

- Contamination in Food: Physical, chemical contaminants- heavy metals, pesticide residues, agrochemicals, Antibiotics and Veterinary Drug residues, environmental pollutants, radionuclides, solvent residues, NOTS (Naturally Occurring Toxic Substances) intentional and unintentional additives in food. ·
- Contaminants formed during processing & packaging – nitrosamines, acrylamide, alloys, benzene, dioxins, furans, persistent organic pollutants, polymers, PAH (Polycyclic Aromatic Hydrocarbons) in smoked foods, food. fumigants, autoxidation products.
- Emerging concerns in food- Microplastics, Bisphenol A, Endocrine Disruptors, Food Allergens, Antimicrobial Resistance (AMR)

DeMan. (2007). *Principles of Food Chemistry*. Springer, 3<sup>rd</sup> edition. Chapter 11 pg no: 429-449.  
Food Safety Standards Regulation, 2011-

## UNIT III

### Introduction and Importance of food additives in Food Processing

12

- Introduction and need of food additives in food processing and preservation. Characteristics and classification of food additives.
- Risk assessment studies- Safety and quality evaluation of additives and contaminants, Acute and chronic studies, NOEL, ADI, LD<sub>50</sub>
- Regulatory limits of additives used commonly in foods. Extraction and use of natural colours in foods.

Brannen, D. and Salminen, T. (2002). *Food Additives*. 2nd edition. New York: Marcel Dekker, Inc Chapter 2 pg. no. 11-28; Chapter 3 pg. no 29-45

## UNIT IV

### Food additives

18

- Chemical, technological and toxicological aspects of following food additives:
- Antimicrobial agents. -Nitrites, sulphides, sulphur di oxide, sodium chloride, hydrogen peroxide.
- Antioxidants - Introduction, mechanism of action, natural and synthetic anti-oxidants, technological aspect of antioxidants.
- Sweeteners- Introduction, importance, classification- natural and artificial, chemistry, technology and toxicology, consideration for choosing sweetening agents.
- Colors- Introduction, importance, classification- natural, artificial, and natural identical, FD&C Dyes and Lakes.
- Recent advances in Food Colours- Use of plant tissue culture, polymeric colors.

Brannen, D. and Salminen, T. (2002). *Food Additives*. 2nd edition. New York: Marcel Dekker, Inc. Chapter 16 pg. no.500-526, Chapter 17 g no. 527-551, Chapter 18 pg no 552-573

DeMan. (2007). *Principles of Food Chemistry*. Springer, 3<sup>rd</sup> edition. Chapter 11 Page no: 443-446

**PRACTICAL****CONTENT****DURATION: 60 HRS (CREDITS 2)**

- Determination of quality standards and inspection of various food grains- cereals and coarse cereals
- Determination of quality standards and inspection of pulses .
- Determination of quality standards and inspection of spices and condiments.
- Qualitative tests for hydrogenated fats, butter, and ghee.
- Estimation of sulphur dioxide in beverages.
- Qualitative estimation of benzoic acid in ketchup and sauces.
- Chromatographic estimation of colour.
- Analysis of edible common salt for moisture content, MIW and total chlorides.
- Estimation of ammonia nitrogen in water.
- Determination of Reichert-Meissl Value and Polenske value in oils and fats.

**COMPULSORY READINGS**

- Brannen, D. and Salminen, T. (2002). *Food Additives*. 2nd edition. New York: Marcel Dekker, Inc.
- DeMan. (2007). *Principles of Food Chemistry*. Springer, 3<sup>rd</sup> edition.
- Pieterneel A, Luning. & Willem, J. Marcelis. (2009). *Food Quality Management Technological and Managerial principles and practices*. Wageningen.

**ADDITIONAL RESOURCES**

- Carol, E., Steinhart, M. and Ellin, D. (1995). *Food Safety*, Food Research Institute. New York: Marcel Dekker, Inc
- Shapton, D.A. and Shapton, N.F.(1998). *Principles and Practices for the safe processing of Foods*. CRC Press.

**TEACHING LEARNING PROCESS**

- Lecture methods
- Power point presentations
- Demonstrations
- Experiential learning through practical

**ASSESSMENT METHODS**

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

**KEYWORDS**

- Department of Food Technology
- Food Quality Management
- Contamination
- Food Additives

- Antioxidants
- Sweeteners

### Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will be able to understand, use and apply the knowledge and skills of quality management in food processing	Discussion on the quality concepts, and its perception and attributes. Concept of quality control and assurance. Quality concept in context with Agri-business, its managerial approach and dynamics on Agri-food production chain.	Quiz, class presentation and working model based questions.
2.	Student will be acquainted with the knowledge of intentional and non -intentional food contaminants in the food chain	Theory classes focusing on different types of contamination (Physical, Chemical and Allergen), which occurred naturally and formed during processing. Major focus will be on emerging concerns with food contaminants.	Class test focusing on short notes and definitions Seminar on recent Concerns.
3.	Students will have in-depth knowledge of importance of food additives in food processing	Interactive lectures on importance of food additives in the food processing. Their types and classification. Risk assessment on their quality and safety using approaches like ADI, LD <sub>50</sub> , NOEL studies etc.	Poster making on types and classification of food additives.
4.	Students will be able to understand the chemical, technological and toxicological aspects of food additives	Detailed discussion on the different types of additives of different origins with respect to their chemical, technological and toxicological aspects. Discussion on different types of colours, their classification and recent advancement in the extraction of new natural colours.	Multiple choice questions and student presentations.

\*Assessment tasks listed here are indicative and may vary.

## DSE FT03: BAKERY TECHNOLOGY (CREDITS: THEORY-4, PRACTICAL-2)

### COURSE OBJECTIVES

- To understand the fundamentals of baking and technology behind various bakery products and breakfast cereals.
- To understand trends in bakery industry.
- To understand technology used in modified bakery products for different health conditions.

### COURSE LEARNING OUTCOMES

- Understand the fundamentals of baking
- Acquire the knowledge of the technologies behind bakery products

- Understand trends in bakery industry
- Get an overview of modified bakery products for different health conditions
- Understand technology behind breakfast cereals and macaroni

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Bakery industry** **10**

- Introduction to bakery technology, current status, growth rate, and economic importance of bakery Industry in India. Types of bakery products, nutritional quality and safety, pertinent standards & regulations, safety concerns related to additives used in bakery products.

NIIR. (2014). *The Complete Technology Book on Bakery Products (Baking Science and Formulations)*. NIIR Project Consultancy Services. Chapter 5-6

**UNIT II**

**Bread, Buns and Pizza base** **12**

- Ingredients & processes for breads, buns, pizza base, changes taking place during baking, equipment used, product quality characteristics, faults and corrective measures

Dubey, S.C. (2007). *Basic Baking* 5th Ed. Chanakya Mudrak Pvt. Ltd. Part I Chapter-1-8

**UNIT III**

**Cakes** **8**

- Ingredients & processes for cakes, equipment used, product quality characteristics, faults and corrective measures. Different types of icings.

Dubey, S.C. (2007). *Basic Baking* 5th Ed. Chanakya Mudrak Pvt. Ltd. Part II Chapter-1-5

**UNIT IV**

**Pastry** **6**

- Ingredients & processes for pastry, product quality characteristics, faults and corrective measures.

Dubey, S.C. (2007). *Basic Baking* 5th Ed. Chanakya Mudrak Pvt. Ltd Part II Chapter 7

**UNIT V**

**Biscuits, Cookies & Crackers** **12**

- Ingredients & processes, equipment used, product quality characteristics, faults and corrective measures.

Dubey, S.C. (2007). *Basic Baking* 5th Ed. Chanakya Mudrak Pvt. Ltd. Part II Chapter 6

Corke, H., De Leyn, I., Nip, W.K. and Cross, N.A., 2008. *Bakery products: Science and Technology*. John Wiley & Sons. Chapter-23

**UNIT VI**

**Modified bakery products** **6**

- Modification of bakery products for people with special nutritional requirements e.g. high fibre, low sugar, low fat, gluten free bakery products, use of fat and sugar replacers, enzymes, egg replacers and natural preservatives in bakery products.

Dubey, S.C. (2007). *Basic Baking* 5th Ed. Chanakya Mudrak Pvt. Ltd. Part II Chapter 6  
Corke, H., De Leyn, I., Nip, W.K. and Cross, N.A., 2008. *Bakery products: Science and Technology*. John Wiley & Sons. Chapter-23

## UNIT VII

6

- **Breakfast cereals and Macaroni products**
- Production of breakfast cereals and macaroni products

Manay, N.S. and Shadaksharaswami, M., 2001. *Food: facts and principles*. New Age International. Chapter 16

## PRACTICAL

## CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Preparation of pizza base and assessment of its quality
- Preparation of bread and assessment of its quality
- Preparation of buns and assessment of quality
- Preparation of butter cake and assessment of its quality.
- Preparation of sponge cake with icing and assessment of its quality.
- Preparation of cookies and assessment of quality.
- Preparation of biscuits and assessment of quality.

## COMPULSORY READINGS

- Corke, H., De Leyn, I., Nip, W.K. and Cross, N.A., 2008. *Bakery products: Science and Technology*. John Wiley & Sons.
- Dubey, S.C. (2007). *Basic Baking* 5th Ed. Chanakya Mudrak Pvt. Ltd.
- Manay, N.S.O., 2001. *Food: facts and principles*. New Age International.
- NIIR. (2014). *The Complete Technology Book on Bakery Products (Baking Science and Formulations)*. NIIR Project Consultancy Services.
- Raina. et.al. (2003). *Basic Food Preparation-A complete Manual*. 3rd Ed. Orient Longman Pvt. Ltd.

## ADDITIONAL RESOURCES

- Barndt, R. L. (1993). *Fat & Calorie – Modified Bakery Products*.US: Springer.
- Bennion, E.B. and Bamford, G.S.T.(1997). *The technology of cake making*. Springer Science & Business Media.
- Faridi, Faubion. (1997). *Dough Rheology and Baked Product Texture*. CBS Publications.
- Manley, D. (2011). ed.*Manley’s technology of biscuits, crackers and cookies*. Elsevier.
- Samuel, A. Matz (1992). *Cookies & Cracker Technology*. Van Nostrand Reinhold
- Samuel, A. Matz (1999). *Bakery Technology and Engineering*. PAN-TECH International Incorporated.

## TEACHING LEARNING PROCESS

- Lecture based
- Power point presentation
- Projects
- Practicals

## ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

## KEYWORDS

Bakery Technology, bread, buns, pizza base, cakes, biscuits, pastry, cookies, modified bakery products, faults, remedies, equipment, ingredients

### Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	An overview of the bakery industry, type of bakery products and safety concerns	Theory classes on growth and development of bakery industry in India	Assignment on different types of bakery industries, market survey of bakery products in the market.
2.	An understanding of the processing of bread buns and pizza base and the types of equipment involved.	Theory class on bread manufacturing process, videos on different types of breads.	Class tests and assignments, quiz.
3.	An understanding of the processing of cakes and the kind of equipment involved thereof.	Theory classes on processing of different types of cakes along with the probable faults and presentation showing pictures of various types of icings.	Drawing the process flow diagrams of cakes and a quiz based assessment.
4.	An insight into the processing of pastries and a learning of their quality characteristics.	Theory classes and example based teaching on the processes of different types of pastries, their presentation with pictures.	Quiz based assessment of different types of pastries.
5.	Students will be acquainted with the understanding of the raw material, processes and equipments used for preparation of various	Practical example based teaching on the utilization of various ingredients, processes and equipments to prepare good quality biscuit and similar products	Student presentations and quiz

	bakery products.		
6	Students will get an overview of modified bakery products for different health conditions	Interactive lectures on utilization of various raw materials to modify existing bakery products for people with special nutritional requirements	Multiple choice questions, Assignments and student presentations
7.	An insight into the manufacturing of breakfast cereals and macaroni products and their types	Theory class and presentations showing pictures of different types of breakfast cereals and macaroni products	Class assignments and tests

\* Assessment tasks listed here are indicative and may vary.

### **DSE FT 04: FOOD PACKAGING (CREDITS: THEORY-4, PRACTICAL-2)**

#### **COURSE OBJECTIVES**

- To impart comprehensive overview of the scientific and technical aspects of food packaging.
- To instill knowledge on packaging machinery, systems, testing and regulations of packaging.

#### **COURSE LEARNING OUTCOMES**

- Comprehend the overview of the scientific and technical aspects of food packaging
- Understand packaging machinery , systems, testing
- An insight to food packaging laws and regulations
- An understanding of packaging requirement and packaging designing of food.

#### **THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

#### **UNIT I**

##### **Introduction to Food Packaging**

**4**

- Definitions, status of packaging industry in India and globally
- Packaging functions
- Barcodes & RFID

Robertson, G.L.(2013) *Food Packaging – Principles and Practice*. CRC Press Taylor and Francis Group, Ch 1,9

#### **UNIT II**

##### **Food Packaging Materials**

**16**

- Manufacturing of paper, types of paper and corrugated fiber board (CFB).



- Food grade plastics ,properties, methods of manufacturing (Injection molding and Blow molding) Biodegradable plastics, edible packaging
- Metals, Tinplate, tin free can (TFC), types of can
- Glass: Composition, Properties, methods of bottle making, types of closures.

Robertson, G.L.(2013) *Food Packaging – Principles and Practice*. CRC Press Taylor and Francis Group, Ch.3, 6,7,8

Coles, R., McDowell, D.& Kirwan, MJ. (2003). *Food Packaging Technology*. Blackwell publication, Ch 5,6,7

### UNIT III

#### Package Designing for Foods

15

Factors affecting spoilage, package requirement and package designing for:

- Fresh horticultural produce
- Animal foods
- Dry and moisture sensitive foods
- Frozen foods
- Fats and oils
- Thermally processed foods

Paine, F.A. and Paine, H.Y. (1992). *A Handbook of Food Packaging*. Blackie Academic and Professional, Ch 7,8,9,10,11,12,13

### UNIT IV

#### Testing of Food Packaging

10

- Testing Procedures for Packaging Materials- thickness, tensile properties, puncture resistance, bursting strength, seal strength, water vapor permeability, gas transmission rate (CO<sub>2</sub> and O<sub>2</sub> permeability), grease resistance
- Compatibility and shelf life studies
- Evaluation of transport worthiness of filled packages

Robertson, G.L.(2013) *Food Packaging – Principles and Practice*. CRC Press Taylor and Francis Group, Ch 4

Paine, F.A. and Paine, H.Y. (1992). *A Handbook of Food Packaging*. Blackie Academic and Professional, Ch 18

### UNIT V

#### Regulatory Aspects of Food Packaging

5

- Environment concerns (RRRR), LCA and method of its estimation
- Food Packaging and Labeling Laws( FSSAI)

Coles, R., McDowell, D.& Kirwan, MJ. (2003). *Food Packaging Technology*. Blackwell publication, Ch 7, [www.fssai.gov.in](http://www.fssai.gov.in)(FSSAI website)

### UNIT VI

#### Packaging Machinery and Systems

10

- Cartoning systems
- Form, Fill and Sealing machine (FFS).
- Vacuum, Controlled and Modified atmosphere packaging systems
- Aseptic packaging systems

- Retort packaging
- Active and Intelligent packaging systems

Robertson, G.L.(2013) *Food Packaging – Principles and Practice*. CRC Press Taylor and Francis Group, Ch 13,15,16

Paine, F.A. and Paine, H.Y. (1992). *A Handbook of Food Packaging*. Blackie Academic and Professional, Ch 4

**PRACTICAL                      CONTENT                      DURATION: 60 HRS (CREDITS 2)**

- Identification of plastic using floatation method.
- Testing of physical/mechanical properties of food packaging material .
- Testing of thermal shock resistance of glass .
- Vacuum packaging of foods and shelf life studies.
- Determination of Water Vapor Transmission rate of Packaging Material.
- Development of biodegradable film.
- Study of Sorption Isotherm for Food Package Design.
- Porosity of tinplate.
- Demonstration of the operation of FFS machine.

**COMPULSORY READINGS**

- Coles, R., McDowell, D.& Kirwan, MJ. (2003). *Food Packaging Technology*. Blackwell publication
- Paine, F.A. and Paine, H.Y. (1992). *A Handbook of Food Packaging*. Blackie Academic and Professional.
- Robertson, G.L.(2012) *Food Packaging – Principles and Practice*. CRC Press Taylor and Francis Group

**ADDITIONAL RESOURCES**

- Coles, R. and Kirwan, M. (2011). *Food and Beverage Packaging Technology*, Wiley-Blackwell publication
- Daniel, Lu. and Wong, D. (Eds). (2017). *Materials for Advanced Packaging*. Springer

**TEACHING LEARNING PROCESS**

- Power point presentation
- Experimental learning through demonstration
- Learning through videos
- Discussion

**ASSESSMENT METHODS**

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

## KEYWORDS

- Department of Food Technology
- Food Packaging Materials
- Package Designing for Foods
- Packaging Machinery and Systems
- Testing of Food Packaging material and package

### Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment task
1	Comprehend the overview of the scientific and technical aspects of food packaging	Practical example based teaching, power point presentation, video	diagrammatic representation, objective and short questions
2	Students can understand different aspects of food packaging material	Diagrammatic representation , flow chart, case studies, video, power point presentation	Diagrammatic representation, short and long questions, objective questions, definitions
3	Students can understand packaging requirement and packaging designing of food	Case studies, situation based problem and solution, group discussion, power point presentation	Situation based problems, , objective and short questions
4	Students can be familiarized with basic principles of testing of packaging material and product from industrial point of view	Numerical, mathematical modelling, Diagrammatic representation, power point presentation, practical exposure	Numerical, flow chart, Diagrammatic representation, short questions
5	Students will get detail information about FSSAI packaging laws and regulations	video, power point presentation, discussion, interactive lectures	objective, short and long questions, quiz, students presentation
6	Students will acquire basic knowledge about packaging machinery and systems and their application in food	Diagrammatic representation, video, discussion, power point presentation,	Diagrammatic representation, definitions, class test

\* Assessment tasks listed here are indicative and may vary.

**DSE FT 06: FOOD PLANT SANITATION  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To obtain knowledge of design of food plant and food processing equipments.
- To understand basic principles of safe and hygienic storage of foods
- To develop basic knowledge of solid and liquid waste management and treatment

**COURSE LEARNING OUTCOMES**

- Gaining detailed knowledge of design of food plant and food processing equipments.
- Develop a basic knowledge of principles of safe and hygienic storage and transportation of fresh plant and animal foods.
- Understanding principles of cold chain management and design of cold stores and warehouses.
- Basic knowledge of solid and liquid waste management and treatment.
- Development of ETP layout
- Knowledge of hygiene and sanitation principles and practices in food industry.
- Understanding of method of determination of BOD and COD.
- Basic understanding of mode of action of detergents and sanitizers.

**THEORY:        CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Food Plant Layout and Equipment Design**

**20**

- General principles of food plant Design and layout
- Design of food processing equipments: Size Reduction, Mixing, Separation, Extraction, Extrusion, Drying ,Freezing, Filtration, Centrifugation, Distillation, Gas absorption equipments

Rao, D. G. (2010). *Fundamentals of Food Engineering*. PHI learning Private Ltd.

Chapter 18(279-319), 19(334-342, 343-361), 20(366-367,377-385), 22(406-409,419-426), 23(441-450), 24(454-464), 25(477-494), 29(562-583)

Fellows, P. (2000). *Food Processing Technology*, 2nd Edition. Woodhead Publishing Limited and CRC Press LLC, Chapter 4-6, pg 98-168.

**UNIT II**

**Warehousing and Cold Chain Management**

**20**

- Food hygiene and safety in transportation, with a focus on warehouse storage and refrigerated ships- Safe food storage at shopping outlets: use of coolers/chillers/freezers, length of time in storage
- Design of warehouses
- Scope of Cold Chain for enhancing marketing potentials of perishables in domestic and international markets, Principle of FIFO.
- Principles of Cold Chain Creation and Management.
- Physicochemical changes in stored products during storage Air tight, Non-air tight, Underground, Conventional & Modern storage structures for fruits, vegetables, meat and marine products

- Aerated, refrigerated and controlled atmospheric storage.
- Layout and Design of storage structures, economics of storage structures

Food and Agriculture Organization of the United Nations & International Institute of Refrigeration. (1984). *Design and operation of cold stores in developing countries*, FAO agricultural services bulletin. Food and Agriculture Organization of the United Nations. ISBN:925101373X, 9789251013731

FAO Agricultural services bulletin 152 “The Role of Post Harvest Management in assuring the quality and safety of horticultural produce”

FAO “ Manual on meat cold store operation and management”

### UNIT III

#### Food Plant Hygiene and Sanitation

20

- Waste disposal,
- Control methods using Physical and Chemical Agents
- Pest and Rodent Control
- ETP Design and Layout
- Food storage sanitation, transport sanitation and water sanitation.
- Guidelines of ISO 22000 for hygiene and sanitation of food processing plant.
- Clean In Place (CIP) Systems
- By-products utilisation obtained from dairy plant, egg & poultry processing industry and meat industry.
- Wastewater and solid waste treatment: - Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary (advanced) treatments.

Norman, G. Marriott. and Robert, B. Gravani. (2006). *Principles of Food Sanitation*, 5<sup>th</sup> edition, Chapter-5-6, pg 76-98, Chapter-9, pg 201-209, Chapter-12-13, pg 213-248, Chapter-5-6, pg 76-98, Chapter-15, pg 268-272.

Hui, Y.H., Bruinsma, B., Gorham, R., Nip, W.-K. (2003). *Food Plant Sanitation*. New York: Marcel Dekker, Chapter- 10, pg 126-131.

#### PRACTICAL

#### CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Design and layout of various food processing systems and food service areas
- Design and layout of cold storage and warehouse
- Determination of physico-chemical properties of wastewater
- Preparation of a sanitation schedule for food preparation area
- Testing of sanitizers and disinfectants
- Study of Phenol coefficient of sanitizers
- Determination of BOD (biological oxygen demand)/ COD in waste water.
- Study of waste water treatment system/ETP

#### COMPULSORY READINGS

- Hui, Y.H., Bruinsma, B., Gorham, R., Nip, W.-K. (2003). *Food Plant Sanitation*. New York: Marcel Dekker.
- Norman, G. Marriott. and Robert, B. Gravani. (2006). *Principles of Food Sanitation*, 5<sup>th</sup> edition.

- Rao, D. G. (2010). *Fundamentals of Food Engineering*. PHI learning Private Ltd.

#### **ADDITIONAL RESOURCES**

- Fellows, P. (2000). *Food Processing Technology*, 2nd Edition. Woodhead Publishing Limited and CRC Press LLC.
- Food and Agriculture Organization of the United Nations & International Institute of Refrigeration. (1984). *Design and operation of cold stores in developing countries*, *FAO agricultural services bulletin*. Food and Agriculture Organization of the United Nations. ISBN:925101373X, 9789251013731
- Forsythe, S.J. and Hayes, P.R. (1998). *Food Hygiene, Microbiology and HACCP*. Gaithersburg, Maryland: Aspen.
- James, A. (2013) *The supply chain handbook*. Distribution group.
- Rees, N. and D. Watson. (2000). *International Standards for Food Safety*. Gaithersburg, Maryland: Aspen

#### **TEACHING LEARNING PROCESS**

- Classroom lectures and notes
- Presentations,
- Videos
- Discussions and demonstrations.
- Field visits
- Case studies
- Projects and assignments

#### **ASSESSMENT METHODS**

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

#### **KEYWORDS**

- Department of Food Technology
- Food Plant Sanitation
- Food Plant Layout and Equipment Design
- Warehousing and Cold Chain Management
- Food Plant Hygiene and Sanitation

#### **Facilitating the achievement of course learning objectives**

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment task
1	Students would understand and comprehend the principles and detailed knowledge of design of food plant and food processing	Practical example based teaching, case studies, Actual physical dimensions	Analysis of process flow chart, Models and Charts preparation,

	equipments	measurements, use of magnetic compass, Visualization, future planning of design and layout, Plant Visit.	discussion and assessment.
2	Students can understand basic principles of safe and hygienic storage and transportation of fresh plant and animal foods.  Understand principles of cold chain management and design of cold stores and warehouses.	Diagrammatic representation, flow chart, case studies, Videos and power point presentations	Discussions, short and long questions, Case studies
3	Students can obtain Basic knowledge of solid and liquid waste management and treatment.  · Development of ETP layout  · hygiene and sanitation principles and practices in food industry, determination of BOD and COD, mode of action of detergents and sanitizers.	group discussion, power point presentation, Videos, ETP Visit, student projects and surveys in and around college campus.	Project reports, survey discussions, Quiz

\* Assessment tasks listed here are indicative and may vary.

### **DSE FT 05: NUTRACEUTICALS AND FUNCTIONAL FOODS (CREDITS: THEORY-4, PRACTICAL-2)**

#### **COURSE OBJECTIVES**

- To understand the types of nutraceutical and functional foods
- To understand the potential of various nutraceuticals and functional foods in promoting human health
- To understand the safety issues and consumer acceptance of nutraceutical and functional foods
- To understand labeling, marketing and regulatory issues related to nutraceutical and functional food

#### **COURSE LEARNING OUTCOMES**

- Understand the types of nutraceutical and functional foods
- Understand the potential of various nutraceuticals and functional foods in promoting human health
- Understand the safety issues and consumer acceptance of nutraceutical and functional foods

- Understand labeling, marketing and regulatory issues related to nutraceutical and functional foods

**THEORY: CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Introduction**

**10**

- Definitions and history
- Difference between nutraceuticals and functional foods
- Current status of nutraceuticals and functional foods in India
- Market trends of nutraceuticals and functional food

Wildman, R.E.C. (2001). *Handbook of Nutraceutical and Functional Foods*. CRC Press, Chapter-1.

**UNIT II**

**Nutraceuticals**

**20**

- Types of nutraceuticals: phytochemicals- isoprenoids, polyphenolics, phytosterols; carbohydrates- (dietary fibers, oligosaccharides and resistant starch); proteins and peptides, lipids- conjugated linoleic Acid, omega-3 fatty acids, fat replacers; vitamins and minerals; microbial- probiotics, probiotics and synbiotic; sources and stability of nutraceuticals
- Health benefits- cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, endurance performance and mood disorders – compounds and their mechanisms of action

Wildman, R.E.C. (2001). *Handbook of Nutraceutical and Functional Foods*. CRC Press, Chapter- 2-10,17-19,25-27.

**UNIT III**

**Functional Foods**

**20**

- Types of functional foods - Cereal and cereal products, milk and milk products, egg, oils, meat and products, sea foods, nuts and oilseeds, functional fruits and vegetables, herbs and spices, beverages (tea, wine), fermented foods
- Potential health benefits and role in cardiovascular diseases, hypertension and diabetes
- Development, formulation and fabrication of functional foods

Wildman, R.E.C. (2001). *Handbook of Nutraceutical and Functional Foods*. CRC Press, Chapter- 11-15,18, 21, 24,25,28.

**UNIT IV**

**Legal Aspects**

**10**

- Safety
- Consumer acceptance
- Assessment of health claims
- Labeling, marketing and regulatory issues
- Future prospects



Wildman, R.E.C. (2001). *Handbook of Nutraceutical and Functional Foods*. CRC Press, Chapter- 30, 31.

**PRACTICAL                      CONTENT                      DURATION: 60 HRS (CREDITS 2)**

- Identification of various nutraceuticals and functional foods available in the market.
- Estimation of chlorophyll content of green vegetable.
- Determination of lycopene in fruit/vegetable.
- Estimation of crude fibre/dietary fibre content in cereals and their products.
- Estimation of anthocyanins in food sample.
- Preparation and evaluation of probiotic/prebiotic foods.
- Estimation of allyl compounds in onions/ garlic.
- Estimation of curcumin content in turmeric.

**COMPULSORY READINGS**

- Wildman, R.E.C. (2001). *Handbook of Nutraceutical and Functional Foods*. CRC Press

**ADDITIONAL RESOURCES**

- Mazza, G. (1988). *Functional foods – biochemical and processing aspects*. USA: Technomic Publ. Lancaster.
- Pathak, Y.V. ( 2011). *Handbook of nutraceuticals*. Volume 2, CRC Press.
- Ranganna, S. (1986). *Handbook of analysis and quality control for fruits and vegetable products*. Tata McGraw-Hill publishing company limited, Second edition
- Various journals of food technology, food science and allied subjects

**TEACHING LEARNING PROCESS**

- Lecture methods
- Power point presentations
- Demonstrations
- Experiential learning through practical

**ASSESSMENT METHODS**

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

**KEYWORDS**

- Department of Food Technology
- Nutraceuticals
- Functional foods
- Polyphenolics
- Probiotics
- Fermented foods

### Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcomes	Teaching and Learning activities	Assessment tasks
1	Students will have a broad perspective of current status and market trends of nutraceuticals and functional food	Detailed discussion on current status and market trends of nutraceuticals and functional foods	Quiz, match the following
2	Students will have in-depth knowledge about types of Nutraceuticals and their potential in promoting human health	Interactive lectures focusing on the types of Nutraceuticals their health benefits. This will followed by discussion on their different sources and their mechanism of action.	Multiple choice questions and student presentations
3	Students will gain knowledge of functional foods	Discussion on the concept, definition and types of Functional foods and their Health benefits.  Theory classes on development, formulation and fabrication of functional foods	Multiple choice questions, match the following, students presentation, quiz, class test focusing on short notes and definitions.
4	Students will be able to understand legal aspects related to nutraceutical and functional food	Theory classes on safety, consumer acceptance, assessment of health claims, labeling, marketing , regulatory issues and future prospects of nutraceutical and functional food	Multiple choice questions, quiz, Class test and students presentation.

**\*Assessment tasks listed here are indicative and may vary.**

# SKILL-ENHANCEMENT ELECTIVE COURSES

## SEC FT 01: ENTREPRENEURSHIP DEVELOPMENT (CREDITS: THEORY-2, PRACTICAL-2)

### COURSE OBJECTIVES

- To develop an insight of Entrepreneurs and Entrepreneurship development.
- To develop and insight for different types of fund raising and to understand the different support system for business development.
- To gain knowledge and acquired skills for setting up an enterprise and its management.

### COURSE LEARNING OUTCOMES

- Develop an insight of Entrepreneurs and Entrepreneurship development. Understand the basics of Business project report and SWOT analysis.
- Develop insight for different types of Fund raising.
- Understand the different support system for business development.
- Gain knowledge and acquired skills for setting up an enterprise and its management.

### THEORY: CONTENT

DURATION: 30 HRS (CREDITS 2)

#### UNIT I

##### Entrepreneurship Development

20

- Entrepreneurship Development: concept, definition, types, functions and competencies
- Stages of entrepreneurship
- Role of creativity & innovation in entrepreneurship
- Barriers and challenges for entrepreneurship in India
- Women entrepreneurship, rural entrepreneurship
- Role of various institutions in developing entrepreneurship in India

Desai, V. (2011) *The Dynamics of Entrepreneurial Development and Management*. Mumbai: Himalya Publishing House Pvt. Ltd. Unit 1, 2, 7

#### UNIT II

##### Business Planning

16

- Idea generation
- Sensing business opportunities and assessing market potential; market research,
- Preparation of feasibility reports/business plan
- Components of project report
- Appraising project report
- Pitching, angel investors, venture capital funds, technology incubators and their role, student start up, technopreneurs, social entrepreneurs and their significance

Desai, V. (2011) *The Dynamics of Entrepreneurial Development and Management*. Mumbai: Himalya Publishing House Pvt. Ltd. Unit 4, 6

### UNIT III

#### Food Business Management: Production, Marketing and finance

24

- Managing Production - Organizing Production; input-output cycle - Ensuring Quality
- Managing Marketing - Understanding markets and marketing - Functions of marketing - 4Ps of marketing
- Financial Management - Meaning of Finance - Types and Sources of Finance - Estimation of project cost - Profit Assessment

Kotler, P. (1994). *Marketing Management*. New Delhi: Prentice Hall of India Private Limited

#### PRACTICAL

#### CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Case study of successful entrepreneurs
- Case study of food business and its aspects
- Ways of sensing opportunities
  - Idea generation
  - Market assessment study: analysis of competitive situation
  - SWOT analysis
- Development and appraisal of business plan
- Visit to an enterprise

#### COMPULSORY READINGS

- Acharya, S.S. & Agarwal, N.L. (1987) *Agricultural Marketing in India*. New Delhi: Oxford & ISH Publishing Co.
- Desai, V. (2011) *The Dynamics of Entrepreneurial Development and Management*. Mumbai: Himalya Publishing House Pvt. Ltd.
- Kotler, P. (1994). *Marketing Management*. New Delhi: Prentice Hall of India Private Limited

#### ADDITIONAL RESOURCES

- David, D. & Erickson, S. (1987) *Principles of Agri Business Management*. New Delhi: Mc Graw Hill Book Co.
- Holt, D.H. (2002). *Entrepreneurship – A new Venture Creation*. New Delhi: Prentice Hall of India.
- Prasanna, C. (1996). *Projects, Planning, Analysis, Selection, Implementation and Review*. New Delhi: Tata McGraw-Hill Publishing Company Limited.
- Taneja, S. & Gupta, S.L. ( ). *Entrepreneur Development- New Venture Creation*. Galgotia Publishing Company.

#### TEACHING LEARNING PROCESS

- Lecture method
- Power point presentations
- Experiential learning through planning and demonstration

## ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- Feedback given to students for improving
- Continuous evaluation of practicals

## KEYWORDS

- Department of Food Technology
- Entrepreneur
- Entrepreneurship Development
- Business startup

### Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Students will be able to develop an insight of Entrepreneurs and Entrepreneurship development	Discussion on the concept, definition, types, functions, competencies and of Entrepreneurship Development, with emphasis on barriers and challenges for entrepreneurship in India, women entrepreneurship role of various institutions in developing entrepreneurship in India.	Multiple choice questions, students presentation, quiz, class test focusing on short notes and definitions.
2.	Students will be able to understand the basics of Business project report, develop insight for different types of Fund raising and understand the different support system for business development.	Theory classes on idea generation, sensing business opportunities and assessing market potential; preparation of feasibility reports/business plan and components of project report. Interactive lectures on pitching, angel investors, venture capital funds, technology incubators, student start up, technopreneurs, social entrepreneurs, etc.	Multiple choice questions, match the following, students presentation, quiz, class test focusing on short notes and definitions.
3.	Students will gain knowledge and acquired skills for setting up an enterprise and its management (production, marketing and financial).	Theory classes on managing production, ensuring quality, managing marketing and its functions, financial management including types and sources of finance and profit assessment.	Students presentation, and class tests, report writing.

\*Assessment tasks listed here are indicative and may vary.

**SEC FT 02: FOOD PRODUCT DEVELOPMENT  
(CREDITS: THEORY-2, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand the concept of development of a new product and prepare new products based on special dietary requirements, functionality, convenience and improvisation of existing traditional Indian foods.

**COURSE LEARNING OUTCOMES**

- Students will have hands on practice & experience of literature survey, idea filtration, prototype product preparation, analysis, packaging & shelf-life study & finally costing.
- This will help students to further take this idea for commercialization & become entrepreneurs

**THEORY:      CONTENT**

**DURATION: 30 HRS (CREDITS 2)**

**UNIT I**

**Introduction**

**02**

- Definition
- Importance
- Types

Fuller G W. (2004). *New Product Development- From Concept to Marketplace*. CRC Press. Chapter-12

**UNIT II**

**Product Development**

**03**

- Need
- Objectives

Fuller, Gordon W. (2004). *New Product Development- From Concept to Marketplace*. CRC Press. Chapter- 1,2,3

**UNIT III**

**Steps of Product Development**

**25**

- Market Survey
- Techno-economic Feasibility
- Proto type product
- Pilot Plants Scale-up
- Process Design
- Analysis and self life study
- Cost Calculation and project report preparation
- Reasons of Product failure in Market

Moskowitz H S R & Sam I,(2009). *An Integrated Approach to New Food Product*. CRC Press. Chapter-4-19

## COMPULSORY READINGS

- Fuller, Gordon W. (2004). *New Product Development- From Concept to Marketplace*. CRC Press.
- Moskowitz, Howard. Saguy ,R. &I. Sam. (2009). *An Integrated Approach to New Food Product*. CRC Press.

## ADDITIONAL RESOURCES

- Anil Kumar, S., Poornima, S.C., Abraham, M.K.&Jayashree, K. (2004). *Entrepreneurship Development*. New Age International Publishers.

## TEACHING LEARNING PROCESS

- Power-point presentations
- Experiential learning through demonstrations
- Conventional White board Method

## ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- Feedback given to students for improving
- Continuous evaluation of practicals

## KEYWORDS

- Product Formulation
- Product Diversification
- Market research
- Prototype product

### Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	To comprehend about NPD & its relevance	Discussion on the meaning, types and importance of NPD	Short & long comprehension based questions
2.	Understand the concept of Food Product Development	Discussion on the basic need and objectives of food product development	Short & long comprehension based questions
3.	Understand the process of food product development	Discussion on the steps of FPD eg. Market survey, idea filtration, prototype product formation, process finalization, microbiological clearance, shelf-life study, pilot plant scale up, broad scale consumer	Short & long tests, application based test & projects

		survey, finalization of process design, market launch, advertising	
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**\*Assessment tasks listed here are indicative and may vary.**

**SEC FT 03: FOOD FERMENTATION TECHNOLOGY  
(CREDITS: THEORY-2, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand the principles of food fermentation technology
- To study the types of starters used in Food Industry
- To study the production of various fermented food

**COURSE LEARNING OUTCOMES**

- An Understanding of the basic components of Food Fermentation Technology and their principles.
- An understanding of the concept of different fermentation process.
- Develop insight for different types of starters used in Food Industry.
- Apply acquired skills in production of various fermented food.

**THEORY:      CONTENT**

**DURATION: 30 HRS (CREDITS 2)**

**UNIT I: Introduction**

**08**

- Fermentation process
- Importance of Fermented products
- Isolation and maintenance of pure culture
- Preparation of substrates/media, inoculums
- Rate of microbial growth and death
- Fermentation Kinetics

Stanbury, P.F., Whitekar A. and Hall (2013). Principles of Fermentation Technology. Reed Elsevier India Pvt.Ltd

**UNIT II: Fermentation Technology**

**10**

- Types of fermentation sub-merged/solid state, Batch/continuous fermentation
- Fermenter design, operation, measurement and control in fermentation
- Recovery of fermentation products and conversion into marketable/storage forms
- Aeration and agitation in fermentation: Oxygen requirement, sterilization of air and media
- Scale up in fermentation

Stanbury, P.F., Whitekar A. and Hall (2013). Principles of Fermentation Technology. Reed Elsevier India Pvt.Ltd



### UNIT III: Fermented Products

12

- Production of baker's yeast, food yeast, Single Cell Protein, Beer, Wine, Cider, Vinegar, Cheese
- Lactic acid Fermentation of milk, vegetables, cereals
- Mushroom cultivation
- IMFL/distilled spirits

Joshi V.K. & Pandey. A. (2009). *Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology*. Volume I and II. Asiatech Publishers Inc

#### **PRACTICAL                      CONTENT                      DURATION: 60 HRS (CREDITS 2)**

- Study of a Bio-fermentor- its design and operation, Downstream Processing and product recovery.
- Solid State Fermentation.
- Fermentation of sugars by yeasts
- Production of Baker's Yeast.
- Production of Yogurt using DIV cultures.
- Development of a fermented food/drink utilizing plant products/animal products or byproducts as substrate.

#### **COMPULSORY READINGS**

- Brian, J. Wood. (1997). *Microbiology of Fermented Foods*. Volume II and I. Elsevier Applied Science Publication.
- Joshi, V.K. & Pandey. A. (2009). *Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology*. Volume I and II. Asiatech Publishers Inc.
- Stanbury, P.F., Whitekar A. and Hall (2013). *Principles of Fermentation Technology*. Reed Elsevier India Pvt.Ltd.

#### **ADDITIONAL RESOURCES**

- Adams, M. & Moss, M. (2008). *Food Microbiology*. 2<sup>nd</sup> Edition. RSC Publishing.
- John, Garbutt. (1997). *Essentials of Food Microbiology*. Arnold International Students Edition.

#### **TEACHING LEARNING PROCESS**

- Power-point presentations
- Experiential learning through demonstrations
- Conventional White board Method
- Audio-Visual Communication

#### **ASSESSMENT METHODS**

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- Feedback given to students for improving
- Continuous evaluation of practicals

## KEYWORDS

- Department of Food Technology
- Food Fermentation Technology
- Fermentation
- Yeast
- Fermentor

### Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Students will be able to develop an insight of the basic components of food fermentation technology and their principles.	Discussion on the concept of fermentation process and also the importance of fermented products, Isolation and maintenance of pure culture, Rate of microbial growth and death with fermentation kinetics.	Multiple choice questions, students presentation, quiz, class test focusing on short notes and definitions.
2.	Students will be able to understand the concept of different fermentation process.	Theory classes on types of fermentation sub-merged/solid state, Batch/continuous fermentation and fermenter design, operation, measurement and control in fermentation. Interactive lectures on recovery of fermentation products and conversion into marketable/storage forms and Scale up in fermentation	Multiple choice questions, match the following, students presentation, quiz, class test focusing on short notes and definitions.
3.	Students will gain knowledge and acquired skills in production of various fermented food	Theory classes on production of fermented products like baker's yeast, food yeast, Single Cell Protein, Beer, Wine, Cider, Vinegar, Cheese, Lactic acid Fermentation of milk, vegetables, cereals, Mushroom cultivation , IMFL/distilled spirits	Multiple choice questions, Students presentation, and class tests.

**\*Assessment tasks listed here are indicative and may vary.**

**SEC FT 04: CONFECTIONARY TECHNOLOGY**  
**(CREDITS: THEORY-2, PRACTICAL-2)**

**COURSE OBJECTIVES**

- Understanding the status of confectionery industry in India
- To learn the technologies of confectionery products
- To know about innovations in this sector

**COURSE LEARNING OUTCOMES**

- Understand the status of confectionery industry in India.
- Attain knowledge of the standards & regulations, quality parameters for sugar, chocolates and other confectionery products.
- Understand the technologies (equipment and process) for confectionary product preparations.

**THEORY:           CONTENT**

**DURATION: 30 HRS (CREDITS 2)**

**UNIT I**

**Introduction**

**6**

Current status and economic importance of Confectionary Industry in India. Confectionery product types and there pertinent standards & regulations.

Minifie, B.W. (1999). *Chocolate, Cocoa and Confectionary*. Aspen Publication. Part 3, pg639-819

**UNIT II**

**Sugars**

**12**

- Sugars- Types and sources
- Methods of preparation of sugars, jaggery, khandsari, raw and refined sugar- quality and properties.
- Principles of sugar cookery, crystalline and non-crystalline candies.

Beckette, S.T. (2009). *Industrial Chocolate Manufacture*. Blackwell Publishing Ltd.ch 3, pg-48-50,64-70

Lees, R. & Jackson, EB. (1992). *Sugar Confectionery and Chocolate Manufacture*. Springer. Ch-2, pg 15-46, ch 10, pg 191-210

Marion Bennion, Barbara Scheule. (2016). *Introductory foods*, 13<sup>th</sup> edition. Pearson, Kent State University, Sweetners and sugar cookery, chapter-11, pg 1170-1350

**UNIT III**

**Confectionary Products**

**12**

- Confectionary Products: Cake icings, hard-boiled candies, toffees, fruit drops, chocolates and other confections- ingredients,equipment's & processes, product quality parameters, faults and corrective measures.
- Cocoa butter, rendering and polymorphism of cocoa fat, properties of fat required for chocolate preparation

Beckette, S.T. (2009). *Industrial Chocolate Manufacture*. Blackwell Publishing Ltd.ch 6, pg-130-139, ch-12, 13, pg- 261-316

Lees, R. & Jackson, EB. (1992). *Sugar Confectionery and Chocolate Manufacture*. Springer. Ch-8, pg 146-148, ch-9, pg 161-190

Marion Bennion, Barbara Scheule. (2016). *Introductory foods*, 13<sup>th</sup> edition. Pearson, Kent State University

- Cocoa butter replacers.

Minifie, B.W. (1999). *Chocolate, Cocoa and Confectionary*. Aspen Publication. pg 85-110

Beckette, S.T. (2009). *Industrial Chocolate Manufacture*. Blackwell Publishing Ltd.ch 19, pg-420-432

## **PRACTICALCONTENT**

## **DURATION: 60 HRS (CREDITS 2)**

- Estimation of Sugar solubility, acidity and sulphated ash content of sugar and jaggery  
Mohini, Sethi. &Eram, Rao. (2011). *Food science- Experiments and applications*, 2nd ed., CBS publishers &Distributors Pvt Ltd. Pg- 2-7  
Ranganna, S.(1986). *Handbook of Analysis and Quality Control for Fruits and Vegetable Products*. II ed. TMH Education Pvt. Ltd, pg-193, 935
- Determine the effect of heat on sugar solution and perform the thread and cold-water test.  
Mohini, Sethi. &Eram, Rao. (2011). *Food science- Experiments and applications*, 2nd ed., CBS publishers &Distributors Pvt Ltd. Pg- 2-7, 9-11.
- To study the process of inversion, melting, caramelization and crystallization in sucrose.  
Mohini, Sethi. &Eram, Rao. (2011). *Food science- Experiments and applications*, 2nd ed., CBS publishers &Distributors Pvt Ltd. Pg- 11-16
- To study the concept of sugar-based product formulation
  - *Shakarpara/Chhana-murki*.  
Mohini, Sethi. &Eram, Rao. (2011). *Food science- Experiments and applications*, 2nd ed., CBS publishers &Distributors Pvt Ltd. Pg- 11-13
  - Fondant/fudge/ brittles.  
Mohini, Sethi. &Eram, Rao. (2011). *Food science- Experiments and applications*, 2nd ed., CBS publishers &Distributors Pvt Ltd. Pg-13-15
  - Candy/ toffee/ fruit drop  
Lees, R. & Jackson, EB. (1992). *Sugar Confectionery and Chocolate Manufacture*. Springer. ch-11, pg 211-217
- To study the tempering of fat in chocolate preparation  
Beckette, S.T. (2009). *Industrial Chocolate Manufacture*. Blackwell Publishing Ltd.ch, 13, pg- 286-290
- To study the effect of cocoa butter replacer in chocolates  
Minifie, B.W. (1999). *Chocolate, Cocoa and Confectionary*. Aspen Publication.pg 85-110
- Visit to confectionary plant to study equipment and processes

## COMPULSORY READINGS

- Beckette, S.T. (2009). *Industrial Chocolate Manufacture*. Blackwell Publishing Ltd.
- Manay, S. & Shadaksharaswami, M. (2004). *Foods: Facts and Principles*. New Age Publishers.
- Minifie, B.W. (1999). *Chocolate, Cocoa and Confectionary*. Aspen Publication.
- Mohini, Sethi. & Eram, Rao. (2011). *Food science- Experiments and applications*, 2nd ed., CBS publishers & Distributors Pvt Ltd.
- Raina et.al. (2003). *Basic Food Preparation-A complete Manual*. 3rd Ed. Orient Longman Pvt. Ltd.

## ADDITIONAL RESOURCES

- Edwards, William. P. (2000). *The Science of Sugar Confectionery*, The Royal society of Chemistry
- Geoff, Talbot. (2009). *Science and Technology of Enrobed and Filled Chocolate, Confectionery and bakery products*. CRC.
- Lees, R. & Jackson, EB. (1992). *Sugar Confectionery and Chocolate Manufacture*. Springer

## TEACHING LEARNING PROCESS

- Class lectures
- Power point presentations
- Experimental learning through demonstrations
- Industrial visit

## ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- Feedback given to students for improving
- Continuous evaluation of practicals

## KEYWORDS

- Food Technology
- Confectionary technology
- Sugar products
- Chocolate and cocoa

### Facilitating the achievement of course learning objectives

Unit No.	Course learning Outcomes	Teaching and learning activities	Assessment tasks
1.	Students will be able to develop an insight of the basic components of food fermentation technology	Discussion on the concept of fermentation process and also the importance of fermented products, Isolation and maintenance of pure	Multiple choice questions, students presentation, quiz,

	and their principles.	culture, Rate of microbial growth and death with fermentation kinetics.	class test focusing on short notes and definitions.
2.	Students will be able to understand the concept of different fermentation process.	Theory classes on types of fermentation sub-merged/solid state, Batch/continuous fermentation and fermenter design, operation, measurement and control in fermentation. Interactive lectures on recovery of fermentation products and conversion into marketable/storage forms and Scale up in fermentation	Multiple choice questions, match the following, students presentation, quiz, class test focusing on short notes and definitions.
3.	Students will gain knowledge and acquired skills in production of various fermented food	Theory classes on production of fermented products like baker's yeast, food yeast, Single Cell Protein, Beer, Wine, Cider, Vinegar, Cheese, Lactic acid Fermentation of milk, vegetables, cereals, Mushroom cultivation , IMFL/distilled spirits	Multiple choice questions, Students presentation, and class tests.

**\*Assessment tasks listed here are indicative and may vary.**

### **SEC FT 05: PROJECT AND TECHNICAL REPORT (CREDITS: PRACTICAL-4)**

#### **COURSE OBJECTIVES**

- To develop a research design on a topic relevant to their field
- To understand the concept of a systematic literature review and report writing

#### **COURSE LEARNING OUTCOMES**

- Demonstrate knowledge of scientific writing method and styles
- Develop a research design on a topic relevant to their field
- Prepare a systematic literature review
- Understand the basic concept of report writing

**PRACTICAL:                      CONTENT                      DURATION: 120 HRS (CREDITS 4)**

#### **UNIT I**

##### **Skills in Technical Writing**

**15**

- Learn the nuances of select technical writing styles/ guides
- Analyze technical posters of researches in the fields
- Analyze research papers, review papers, research reports and project evaluation reports and their presentations
- Critically review an article

## UNIT II

### Review of Literature

20

- Prepare a literature review on a specific topic
- Conduct Plagiarism check of document prepared

## UNIT III

### Project report & Seminar

25

- Preparation of project report
- Present an oral seminar on the topic

## TEACHING LEARNING PROCESS

- Power point presentations
- Experiential learning through demonstrations
- Use of ICT
- E-learning resources

## ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- Feedback given to students for improving

## KEYWORDS

- Department of Food Technology
- Project report
- Technical report

### Facilitating the achievement of course learning objectives

Unit No.	Course learning Outcomes	Teaching and learning activities	Assessment tasks
1.	Students will be able to develop an insight of the basic components of food fermentation technology and their principles.	Discussion on the concept of fermentation process and also the importance of fermented products, Isolation and maintenance of pure culture, Rate of microbial growth and death with fermentation kinetics.	Multiple choice questions, students presentation, quiz, class test focusing on short notes and definitions.
2.	Students will be able to understand the concept of different fermentation process.	Theory classes on types of fermentation sub-merged/solid state, Batch/continuous fermentation and fermenter design, operation, measurement and control in fermentation. Interactive lectures on recovery of fermentation products and conversion into marketable/storage forms and Scale up in fermentation	Multiple choice questions, match the following, students presentation, quiz, class test focusing on short notes and definitions.

3.	Students will gain knowledge and acquired skills in production of various fermented food	Theory classes on production of fermented products like baker's yeast, food yeast, Single Cell Protein, Beer, Wine, Cider, Vinegar, Cheese, Lactic acid Fermentation of milk, vegetables, cereals, Mushroom cultivation , IMFL/distilled spirits	Multiple choice questions, Students presentation, and class tests.
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**\*Assessment tasks listed here are indicative and may vary.**



# GENERIC ELECTIVES

## GE FT 01: FOOD PROCESSING AND PRESERVATION (CREDITS: THEORY-4, PRACTICAL-2)

### COURSE OBJECTIVES

- To impart basic concept of Food colloids, Freezing, Dehydration processes and equipment used during the processing
- To understand the Principles of thermal processing, Minimal Processing and hurdle technology
- To understand the concepts of water disposal and sanitation.

### COURSE LEARNING OUTCOMES

- Understand the basic concepts of Food colloids, Freezing, Dehydration processes and equipment used during the processing
- Understand the Principles of thermal processing, Minimal Processing and hurdle technology
- Understand the concepts of water disposal and sanitation.

### UNIT I

#### Food Processing Operations

20

- **Refrigeration and Freezing**

Requirements of refrigerated storage - controlled low temperature, air circulation and humidity, changes in food during refrigerated storage, progressive freezing, changes during freezing Freezing methods - direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.

- **Dehydration**

Normal drying curve, effect of food properties on dehydration, change in food during drying, drying methods and equipments air convection dryer, tray dryer, tunnel dryer, continuous belt dryer, fluidized bed dryer, drum dryer, vacuum dryer, freeze drying, foam mat drying.

- **Thermal Processing of Foods**

Classification of thermal processes, Principles of thermal processing, commercial canning operations, Aseptic Processing, UHT. Irradiation and microwave heating. Principles, Dosage, Applications of Irradiation, Mechanism of microwave heating and applications.

Potter, N.H. (1998). *Food Science*. New Delhi: CBS Publication. Chapter 8,9,10,11, pg no 138-142, 163-175, 200-232, 245-262

Ramaswamy, H. and Marcotte, M. (2009). *Food Processing Principles and Applications*. CRC Press. Chapter, pg No-73-89

## UNIT II

### Technology of Colloids in Food

12

- Characteristics, sols, gels, pectin gels, colloidal sols, stabilization of colloidal system, syneresis, emulsions, properties of emulsions, formation of emulsion, emulsifying agents, food foams, formation stability and destruction of foam, application of colloidal chemistry to food preparation

Manay, N.S. and Shadaksharaswamy, M. (1987) *Food-Facts and Principles*. New Delhi: New Age International (P) Ltd. Publishers., Chapter 11, pg no-145-149

## UNIT III

### Water Disposal and Sanitation

8

- Waste water, hardness of water, break point chlorination, physical and chemical nature of impurities, BOD, COD, waste water treatment, milk plant sanitation, CIP system, sanitizers used in food industry.

Potter, N.H. (1998). *Food Science*. New Delhi: CBS Publication. Chapter 22 pg no 514-528

## UNIT IV

### Minimal processing and hurdle technology

5

<https://www.crcpress.com/Handbook-of-Food-Preservation/Rahman/p/book/9781574446067>

## UNIT V

### Food Additives, Contaminants and Regulations

15

- Food Additives - Introduction, need of food additives in food processing and preservation, Characteristics and classification of food additives, Chemical, technological and toxicological aspects.
- Contamination in Food- : Physical, chemical (heavy metals, pesticide residues, antibiotics, veterinary drug residues, dioxins, environmental pollutants, radionuclides, solvent residues, chemicals) Natural toxins. Food Laws and Regulations- Codex, HACCP, ISO, FSSA

Demian, J.M. (2007). *Principles of Food Chemistry*, 3rd Ed. Springer. Chapter 11,12 pg No 429-445, 475-488

## PRACTICAL

## CONTENT

DURATION: 60 HRS (CREDITS 2)

- Canning of foods
- Preservation of food by the process of freezing
- Drying of food using Tray dryer/other dryers
- Estimation of Chemical Oxygen Demand (Demonstration)
- Preparation of brix solution and checking by hand refractometer
- Analysis of water
- Minimal Processing of food
- Application of colloidal chemistry in food preparation

## COMPULSORY READINGS

- Deman, J.M. (2007).*Principles of Food Chemistry*, 3rd Ed.Springer.
- Manay, N.S. and Shadaksharaswamy, M. (1987) *Food-Facts and Principles*. New Delhi: New Age International (P) Ltd. Publishers.
- Potter, N.H. (1998).*Food Science*.New Delhi: CBS Publication.
- Ramaswamy, H. and Marcotte, M. (2009).*Food Processing Principles and Applications*. CRC Press.

## ADDITIONAL RESOURCES

- Branen, A., Larry,Davidson., P. Michael, Salminen, Seppo.& Thorngate, John. (1990).*Food Additives*2nd Edition.New York: Marcel Dekker.

## TEACHING LEARNING PROCESS

- Power point presentations
- Experiential learning through demonstrations

## ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

## KEYWORDS

- Department Food Technology
- Food Preservation
- Food Processing

### Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	Students will gain knowledge on low temperature preservation techniques like refrigeration and freezing and also different freezers used in food industries	Interactive theory classes and also through power point presentation	Class test focusing on definitions and short questions
	Students will be acquainted on concept of high temperature preservation like dehydration and drying and how it affects the food properties.	Detailed discussion on the principles of dehydration and also showing power point presentations	Class test, quiz and multiple-choice questions

	Students will acquire in-depth knowledge of thermal and non-thermal processing to preserve food	Theory class and Interactive session on different processes.	Quiz and subjective test
2	Students will learn and understand the concept of colloids in food and their application	Discussion and detailed theory lectures on concept and their application	Class test focusing on definitions and long subjective questions
3	Students will have gathered information on waste treatment processes in industries	Detailed theory class and interactive session	MCQ's and subjective test.
4	Students will learn and describe the concept of minimal processing and hurdle technology	Interactive session and theory classes	Class test and student's presentation
5	Students will have gathered information on rules and regulations prevalent in industries pertaining to food additives and contaminants	Discussion and detailed theory lectures on concept and their application	Class test focusing on definitions and long subjective questions

\* Assessment tasks listed here are indicative and may vary.

## **GE FT 02: CHEMISTRY OF FOOD (CREDITS: THEORY-4, PRACTICAL-2)**

### **COURSE OBJECTIVES**

- To understand the chemistry of foods - composition of food, role of each component
- To understand the effect of processing on various food components

### **COURSE LEARNING OUTCOMES**

- To understand the chemistry of foods - composition of food, role of each component
- To understand the effect of processing on various food components

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

### **UNIT I**

#### **Introduction and Water**

**8**

- Introduction to Food Chemistry, Composition of food
- Definition of water in food, Structure of water and ice, Types of water, Role of water activity

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 1

## UNIT II

### Lipids & Protein

12

- Classification of lipids, Physical and chemical characteristics, Chemical deterioration of fats and oils (auto oxidation, rancidity, lipolysis, flavor reversion)
- Protein classification and structure, types of food proteins (plant and animal proteins), Physicochemical and functional properties of proteins

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 2 & 3

## UNIT III

### Carbohydrates and Flavour

8

- Classification, Structure and Chemical reactions of carbohydrates
- Definition and basic tastes, Description of some common food flavors

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 4 & 7

## UNIT IV

### Vitamins & Minerals

8

- Types (Water soluble vitamins and Fat soluble vitamins)
- Major and minor minerals, Toxic minerals in food

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 5&9

## UNIT V

### Natural Food Pigments, Enzymes & Browning Reactions in Food

14

DeMan J M, (2005). Principles of Food Chemistry. AVI Publisher. Chapter 6 & 10

Fennema O R, (1996). *Food Chemistry*, publisher- New York: Marcell Dekker. Chapter-10.

## UNIT VI

### Physico-chemical and nutritional changes occurring during food Processing& New Food Product Development

Desrosier N W & Desrosier J N. (1977). *The technology of food preservation*. AVI Publisher. Chapter-4<sup>th</sup> & 5<sup>th</sup>

## PRACTICAL

## CONTENT

DURATION: 60 HRS (CREDITS 2)

- Preparation of primary and secondary solutions
- Estimation of moisture content
- Determination of gelatinization temperature range (GTR) of different starches and effect of additives on GTR
- Determination of percent free fatty acids
- Estimation of Peroxide Value
- Estimation of Total Ash

## COMPULSORY READINGS

- DeMan, John M.(1982). *Principles of Food Chemistry*. 3rd Ed., Springer.
- Desrosier, Norman W. & Desrosier,James N. (1977).*The technology of food preservation*, 4th Ed.,Westport, Conn.: AVI Pub. Co.

- Fennema, Owen R. (1996). *Food Chemistry*, 3rd Ed. New York: Marcell Dekker.

#### **ADDITIONAL RESOURCES**

- Potter, N.N. and Hotchkiss, J.H. (1995). *Food Science* 5th Ed. New York: Chapman & Hall.
- Whitehurst. and Law. (2002). *Enzymes in Food Technology*. Canada: CRC Press.
- Wong, Dominic WS. (1885). *Food Enzymes*. New York: Chapman and Hall.

#### **TEACHING LEARNING PROCESS**

- Power-point presentations
- Experiential learning through demonstrations
- Conventional White board Method
- Videos

#### **ASSESSMENT METHODS**

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

#### **KEYWORDS**

- Department of Food Technology
- Chemistry of food
- Food composition
- Food analysis

#### **Facilitating the achievement of course learning objectives**

<b>Unit No</b>	<b>Course learning outcomes</b>	<b>Teaching and learning activities</b>	<b>Assessment Tasks</b>
1.	Students will get acquainted with the concept of chemistry of food and learn about the basic component of food-Water	Interactive session and detailed discussion on introduction and structure of water and ice and their role in food	Objective type questions and also through presentation

2.	Students will understand and gain knowledge about the major components of food-Lipid and Protein	Interactive theory classes and discussion on the structure and characteristics of lipids and proteins and also describe about its functional properties	Multiple choice questions, short notes
3.	Students will understand and describe the chemical structure of carbohydrates and different flavours associated with food	Detailed discussion and interactive theory sessions on the structure and chemical properties of carbohydrates and various flavours	Objective type question and short notes
4.	Students will understand and gather knowledge on the minor components of food-Vitamin and mineral	Discussion and detailed theory lectures on the structure, processing and properties of vitamins and minerals	Short and long notes, student presentation
5.	Students will understand the basic structure of pigments, enzymes and mechanism of browning reactions occur in foods	Detailed discussion and interactive theory sessions on the structure and the effect of processing on their properties, also their application in food industries	Subjective and objective type tests
6.	Students will understand the effect of different preservation techniques on the food quality and also the concept, need and importance of new product development	Discussion and detailed theory lectures on the effect of different techniques on the different parameters of food, and also the concept of new product development	Short and long notes, student presentation

**\* Assessment tasks listed here are indicative and may vary.**

**GE FT 03: SENSORY EVALUATION OF FOOD**  
**(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand sensory organs and their role in sensory evaluation
- To obtain a basic knowledge of objective and subjective evaluation of food
- To know the importance of sensory panels and testing methods.
- Understanding the application of sensory evaluation in food industry.

**COURSE LEARNING OUTCOMES**

- Learners will have an insight of 4 basic tastes and derived tastes in food.
- Basic understanding of flavours, colours and texture in foods.
- Concept of sensory panels and various instruments used in assessing the quality parameters of food.

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Taste**

**15**

- Introduction and importance of taste
- Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands
- Mechanism of taste perception
- Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami
- Factors affecting taste quality, reaction time, taste modification, absolute and recognition Threshold
- Taste abnormalities
- Taste measurement

Rao, E. S. (2013). *Food Quality Evaluation* (1st ed.). New Delhi: Variety Book Publishers. Chapter 6 pg. 153-186

**UNIT II**

**Odour**

**15**

- Introduction, definition and importance of odour and flavor
- Anatomy of nose, physiology of odour perception
- Mechanism of odour perception
- Odour classification, chemical specificity of odour.
- Odour measurement using different techniques –historical perspective and emphasis on recent techniques like e-nose. Merits and demerits of each method. Olfactory abnormalities

**UNIT III**

**Colour**

**15**

- Introduction and importance of colour.



- Dimensions and attributes of colour, appearance factors, gloss etc.
- Perception of colour.
- Colour abnormalities
- Measurement of colour; Munsell colour system, CIE colour system, Hunter colour system, spectrophotometry, colorimetry, advances in colour measurement.

Rao, E. S. (2013). *Food Quality Evaluation* (I ed.). New Delhi: Variety Book Publishers. Chapter 5 pg. 111- 148

#### UNIT IV

##### Texture

15

- Introduction, definition and importance of texture
- Phases of oral processing
- Texture perception, receptors involved in texture perception
- Texture classification
- Texture measurement – basic rheological models, forces involved in texture measurement
- Some objective methods of texture evaluation of foods- mixograph, amylograph, spreadimeter, compressimeter etc.

Rao, E. S. (2013). *Food Quality Evaluation* (I ed.). New Delhi: Variety Book Publishers. Chapter 8, 9, 15, 16, 19 pg. 203-231pg 243-278, pg. 329-345, 357-376, 401- 427

#### PRACTICAL

#### CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Training of sensory panel.
- To perform recognition and sensitivity tests for four basic tastes.
- To perform analytical tests of sensory evaluation.
- Recognition tests for various food flavours.
- Flavor defects in milk.
- Sensory evaluation of dairy products-milk/cheese/butter/ice cream.
- Extraction of pigments from various fruits and vegetables and study the effect of temperature and pH.
- Texture Profile Analysis of any food product- cookies/ biscuits/chips/fruits.
- Measurement of colour by using Tintometer/ Hunter Colour Lab etc.
- Texture evaluation of various food samples using texture analyser (if available).

#### COMPULSORY READINGS

- DeMan, J. (2007). *Principles of Food Chemistry*, 3rd ed., Springer.
- Meilgard. (1999). *Sensory Evaluation Techniques*, 3rd ed. CRC Press LLC.
- Rao, E. S. (2013). *Food Quality Evaluation*, Variety Books.

#### ADDITIONAL RESOURCES

- Amerine, Pangborn.& Roessler. (1965). *Principles of Sensory Evaluation of food*. London: Academic Press,.
- Harry, T., Lawless, Barbara. & P. Klien. (1991). *Sensory science thoery and applications in FOOD*. Marcel Dekker, Network.

- Rao. E.S. (2014) *Food Quality testing and Evaluation- Sensory Test Instrumental Techniques*. New Delhi: Variety Book Publishers Distributors, 2013. ISBN: 9381156212, 978938115621

### TEACHING LEARNING PROCESS

- Conventional white board method
- Power Point Presentation
- Videos
- Assignment

### ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

### KEYWORDS

- Department of Food Technology
- Sensory Evaluation
- Taste of Food
- Odour of Food
- Colour of Food
- Texture of Food

### Facilitating the achievement of course learning objectives

Unit no	Course learning outcomes	Teaching and learning activities	Assessment task
1	Chemistry of five basic tastes and their perception through tongue	To present the basic tastes to learners for identification. Also to find absolute and recognition thresholds. The evaluation cards preparation for various tests.	The tastes are coded and given for identification. Learners are rated based on correct identification. Quiz based on above.
2	Identification of various types of odours their perception and measurement.	Odours are presented using various natural food substances.	Coding of odours and their identification by students. Quiz and assignments given.
3	Various attributes of color and their objective measurement in foods is understood.	Spectrophotometric assessment of colors ( $\lambda$ max) and study of color using Lovibond tintometer.	Various natural and artificial colors are presented to learners and expressed using Lovibond system. Presentations on

			above.
4	Concept of texture and its objective assessment. Rheology of all food groups and instruments used.	Various samples of foods are assessed in subjective as well as objective ways.	Learners are given different kinds of food to study using texture analyser n study the graphical expression. The final evaluation by test as well as mock practical exam.

\* Assessment tasks listed here are indicative and may vary.

**GE FT 04: FOOD MICROBIOLOGY AND FOOD SAFETY  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand the important genera of microorganisms associated with food and their characteristics.
- To understand the role of microbes in fermentation, spoilage and food borne diseases.
- To understand Food safety and hygiene, types of hazards associated with food
- To understand current Food Regulations and Food Safety Management Systems.

**COURSE LEARNING OUTCOMES**

- Acquaint the knowledge of the important genera of microorganisms associated with food and their characteristics.
- Able to explain the role of microbes in fermentation, spoilage and food borne diseases.
- Describe Food safety and hygiene, types of hazards associated with food
- Understand current Food Regulations and Food Safety Management Systems.

**THEORY:      CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Introduction to Food Microbiology and Types of Microorganisms in Food      10**

- Definition and Scope of food microbiology
- Classification and Types of Microorganisms in food (bacteria, fungi and viruses ), Significance of spores

**UNIT II**

**Microbial Growth in Food and Food Spoilage      12**

- Bacterial growth curve, Factors affecting the growth of micro-organisms in food

- Sources of Microorganisms in foods, Some important food spoilage bacteria, Spoilage of some specific food groups

### **UNIT III**

#### **Food Fermentations**

**8**

- Fermentation –definition and types, Microorganisms used in food fermentations
- Fermented Foods-types, methods of manufacture for vinegar, sauerkraut, yoghurt, soya sauce, wine and traditional Indian foods

### **UNIT IV**

#### **Food borne diseases, Preservation methods and Enumeration techniques.**

**15**

- Types – food borne infections, food borne intoxications and toxin infections
- Enumeration techniques Standard Plate Count (conventional and automated), Agar droplet, Direct Microscopic Count, Direct Epi florescent Filtration Technique,
- Principles and methods of preservation (thermal and non thermal viz. Pulsed Electric Field, High Hydrostatic Pressure, Irradiation) Introduction to Hurdle Technology

### **UNIT V**

#### **Food Safety and regulations**

**15**

- Food safety: Definition, Types of hazards, biological, chemical, physical hazards, Factors affecting Food Safety
- Hygiene and Sanitation in Food Service Establishments: Introduction, Control methods using physical and chemical agents, Waste Disposal, water analysis, Personnel Hygiene
- Food Safety Management Tools: Basic concept, Prerequisites, HACCP, ISO series, TQM and Risk Analysis
- Regulations: FSSA, Codex

### **PRACTICAL**

### **CONTENT**

**DURATION: 60 HRS (CREDITS 2)**

- Introduction to the Basic Microbiology Laboratory Practices and Equipments
- Preparation and sterilization of nutrient broth and media
- Morphological study of bacteria and fungi using permanent slides
- Simple staining and Gram's staining
- Standard Plate Count Method
- Bacteriological Analysis of Water
- Assessment of surface sanitation by swab/rinse method
- Assessment of personal hygiene
- Implementation of FSMS – HACCP, ISO : 22000

### **COMPULSORY READINGS**

- Forsythe, S J. (1987) *Microbiology of Safe Food*. USA: Blackwell Science, Oxford, 2000 65 & Sons.
- Frazier, William C. and Westhoff, Dennis C. (2004). *Food Microbiology*. New Delhi: TMH.

- Garbutt, John.(1997). *Essentials of Food Microbiology*. London: Arnold.
- Jay, James M. (2000). *Modern Food Microbiology*.New Delhi: CBS Publication.
- Mathur, P. (2018). *Food Safety and Quality Control*. Hyderabad: Orient BlackSwan Pvt. Ltd.

### ADDITIONAL RESOURCES

- De Vries. (1997). *Food Safety and Toxicity*.New York: CRC.
- Lawley, R., Curtis L. and Davis,J. (2004). *The Food Safety Hazard Guidebook*. RSC Publishing.
- Marriott, Norman G. (1985). *Principles of Food Sanitation*. New York: AVI.
- Pelczar, M.J., Chan E.C.S and Krieg, Noel. R. (1993) *Microbiology*, 5th Ed.New Delhi: TMH.

### TEACHING LEARNING PROCESS

- Power point presentations
- Experiential learning through demonstrations

### ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

### KEYWORDS

- Department of Food Technology
- Food Microbiology
- Food Safety
- Microorganisms

### Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will be able to understand the knowledge of the important genera of microorganisms associated with food and their characteristics	Teaching will be done on discussion mode through lectures. Major learning activities will be through extempore discussions and application in and around environment food.	Quiz, project presentation and discussion
2, 3	Students will be taught to understand the role of microbes in fermentation, spoilage and food borne diseases.	Teaching will be done through lectures and discussion mode. Plant visits will be organized for better understanding of the concept.	Quiz, project presentation and discussion
4.	Students will be able to	Teaching will be done through	Quiz, project

	describe Food safety and hygiene, types of hazards associated with food	lectures and discussion mode.	presentation and discussion
5.	Understand current Food Regulations and Food Safety Management Systems	Teaching will done through lectures and discussion mode.	Quiz, project presentation and discussion

\* **Assessment tasks listed here are indicative and may vary.**

## **GE FT 05: FOOD ENGINEERING AND PACKAGING (CREDITS: THEORY-4, PRACTICAL-2)**

### **COURSE OBJECTIVES**

- To understand the principles of Unit operation
- To acquaint with fundamentals of food engineering and its process
- To develop an understanding of different food packaging materials and packaging design and techniques used for various foods

### **COURSE LEARNING OUTCOMES**

- Understand the principles of Unit operation
- Acquaint with fundamentals of food engineering and its process
- An understanding of different food packaging materials and packaging design and techniques used for various foods

### **THEORY: CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

#### **UNIT I**

#### **Unit Operations and Processes**

**30**

- Introduction
- Units and Dimensions
- Modes of heat transfer
- Mass transfer-Diffusion
- Membrane separation processes
- Steam generation and Boilers
- Evaporation
- Drying and dehydration
- Refrigeration and Freezing
- Psychometrics
- Fluid flow.

Singh, R.P. and Heldman, D.R.(1993).*Introduction to food engineering*, 2ndEd. Academic Press, Ch 1-12

#### **UNIT II**

#### **Separation and Size Reduction Processes**

**10**

- Principles and equipment used in following:
  - Separation

- Extraction
- Sedimentation
- Filtration
- Centrifugation
- Size reduction – Milling, grinding and mixing of foods

Fellows, P. (2000). *Food processing technology*. Woodhead publication, 2nd edition, Ch 4, 5,6

### UNIT III

#### Introduction to Food Packaging

10

- Objectives and functions of food packaging
- Requirements for effective food packaging
- Types of packaging Materials
- General properties of packaging materials

Paine, F.A. and Paine, H.Y.(1992). *A Handbook of Food Packaging*. Blackie Academic Professional.,Ch1

### UNIT IV

#### Packaging of Foods

10

- Packaging of fresh produce and processed foods
- Aseptic packaging
- Advances in food packaging

Paine, F.A. and Paine, H.Y.(1992). *A Handbook of Food Packaging*. Blackie Academic Professional.Ch 7,8,10

#### PRACTICAL

#### CONTENT

**DURATION: 60 HRS (CREDITS 2)**

- Study the dehydration process
- Study the freezing characteristics of foods
- Study the process of evaporation
- To design layout of a food plant
- Determination of viscosity of foods
- Identification of packaging materials
- Testing of packaging materials
- Demonstration of vacuum/gas packaging of foods

#### COMPULSORY READINGS

- Paine, F.A. and Paine, H.Y.(1992). *A Handbook of Food Packaging*. Blackie Academic Professional.
- Fellows, P. (2000). *Food processing technology*. Woodhead publication, 2nd edition,

#### ADDITIONAL RESOURCES

- Rao, D.G.(2010). *Fundamentals of food engineering*. PHI learning private Ltd.
- Robertson, G.L.(2012). *Food Packaging – Principles and Practice*. CRC Press Taylor and Francis Group

#### TEACHING LEARNING PROCESS

- Power point presentation
- Demonstration

- Video
- Discussion

### ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

### KEYWORDS

- Food packaging
- Unit operations
- Separation process
- Size reduction

### Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment task
1	Students would understand and comprehend the principle of unit operations	Practical example based teaching, Theory classes for derivation, , power point presentation	Numerical, derivation, diagrammatic representation of mass and energy balance, flow chart
2	Students can understand principles of separation and size reduction processes in food	Diagrammatic representation , flow chart, video	Diagrammatic representation, short and long questions
3	Students can understand different food packaging materials and their applications	group discussion, power point presentation, case studies, video	objective and short questions, graphical presentation, class test
4	Students can be familiarized with packaging design and techniques used for various foods	Diagrammatic representation, power point presentation, video, discussion,	Diagrammatic representation , situation based short and long questions

\* Assessment tasks listed here are indicative and may vary.



**GE FT 06: TECHNOLOGY OF PLANT AND ANIMAL FOODS  
(CREDITS: THEORY-4, PRACTICAL-2)**

**COURSE OBJECTIVES**

- To understand the compositional and technological aspects of meat, egg, milk and fish.
- To understand processing of fruits,vegetables,cereals,pulses and oilseeds
- To understand processing of various spices, tea, coffee and cocoa

**COURSE LEARNING OUTCOMES**

- Understand the importance of meat, egg, dairy and poultry industry
- Understand the compositional and technological aspects of meat, egg, milk and fish.
- Understand different methods of fruits and vegetable processing
- Understand technical knowhow of Cereals, pulses and oilseeds processing
- Understand processing of various spices, tea, coffee and cocoa

**THEORY: CONTENT**

**DURATION: 60 HRS (CREDITS 4)**

**UNIT I**

**Technology of Fruits and Vegetables**

**12**

Introduction and importance of fruit and vegetable preservation, history and need of preservation. Canning and bottling of fruits and vegetables: Selection of fruits and vegetables, process of canning, containers of packing, spoilage in canned foods. Fruits beverages: Introduction, process and preservation of fruit juices .Jams, jellies and marmalades: Processing and technology, defects in jelly.

Girdharilal., Siddappaa, G.S and Tandon, G.L. (1998). *Preservation of fruits & Vegetables*. New Delhi: ICAR, Chapter-1-2, pg 8-37, Chapter-7, pg 76-83, Chapter-9, pg 115-135, Chapter-11, pg 140-173.

**UNIT II**

**Technology of cereals, legumes and oilseeds**

**12**

Wheat - Types, milling, flour grade. Rice – Variety, milling, parboiling. Corn – Variety, milling, Millets - milling. Pulses- Dry and wet milling, Oilseeds- Extraction of oil and refining.

Kent. N.L. (2003). *Technology of Cereal*. 5th Ed. Pergamon Press, Chapter- 4-7, Chapter- 15-16, Chakraborty. (1988). *Post Harvest Technology of Cereals, Pulses and Oilseeds*, revised ed. Oxford & IBH Publishing Co. Pvt Ltd, Chapter 12-13, pg 327-396, Chapter 15, pg 427-453.

**UNIT III**

**Spices &Plantation Products**

**6**

Spices - Processing and properties of important spices. Tea and Coffee: Processing

Srilakshmi. (2007). *Food Science*, 4th Edition. New Age International Ltd, Chapter-12, pg 252-263.

**UNIT IV**

**Dairy and Fish Technology**

**12**

Dairy – FSSAI Definition of Milk, Types of Market Milk, Physico-chemical properties of milk, processing of Milk, Concept of Filtration, Clarification, Homogenization, Pasteurization,

Introduction to various Milk Products: Butter, ghee, flavored milk, yoghurt, dahi, shrikhand, icecream, condensed milk, milk powder, channa, paneer, cheese (cheddar).

Sukumar, D. (2007). Outlines of dairy technology. Chapter 1, 1-90, Chapter 4, 143, Chapter 6 page no.182, Chapter 7, page no. 224, Chapter 8, page no. 268, Chapter 10, page no. 309

Fish – Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical, Methods of Fish Preservation chilling, freezing, Drying, salting, smoking.

Sen, D.P. (2005). *Advances in Fish Processing Technology*. Allied Publishers Pvt.Limited. Chapter 4 Page no 151, Chapter 7 Page no 254

Hall, G.M. (1992). *Fish Processing Technology*. NY: VCH Publishers. Chapter 3 Page no 74-90.

Hall, G.M. (1992). *Fish Processing Technology*. NY: VCH Publishers. Chapter 2 Page no 32-72.

Hall, G.M. (1992). *Fish Processing Technology*. NY: VCH Publishers. Chapter 4 Page no 93-117.

## UNIT V

### Meat and Poultry Technology

12

Meat and Poultry – Definition of carcass, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat, Concept of an abattoir, Process of slaughtering in an abattoir.

Lawrie, R. A. (1998). *Lawrie's meat science*. 5<sup>th</sup> ed. England: Woodhead Publishing Ltd. Chapter 1, 2, pg -5-30, chapter 10, pg 280-337, Chapter 7,8,9, pg 189-270.

Shai, Barbut. (2005). *Poultry Products Processing*. CRC Press. Chapter 13,14, pg -435- 516.

## UNIT VI

### Egg Technology

6

Egg – Structure and composition of hen's egg, egg proteins, characteristics of fresh egg, deterioration of egg quality. Preservation of eggs, egg powder.

Stadelman, W. J., Newkirk, D., & Newby, L. (2002). *Egg science and technology*. 4<sup>th</sup> ed. New Delhi: CBS Publication. Ch 1, 2, pg 9-35, Ch 3, 4, pg-37-66

Parkhurst, C., & Mountney, G. J. (1997). *Poultry meat and egg production*. New Delhi: CBS Publishers. Chapter 1, pg 1-5, ch 7, pg- 97-106, ch 16, pg 266-284

## PRACTICAL

## CONTENT

DURATION: 60 HRS (CREDITS 2)

- Physical Characteristics of Wheat
- Estimation of gluten content of flour
- Estimation of degree Brix : Acid ratio
- Estimation of percent Ascorbic acid
- Platform tests in milk.(Acidity, COB, specific gravity)
- Evaluation of eggs for quality parameters(market eggs, branded eggs)
- Cut out examination of canned fish(Sardine,Mackerel,Tuna)/Meat.
- To prepare casein and calculate its yield

## COMPULSORY READINGS

- Chakraborty. (1988). *Post Harvest Technology of Cereals, Pulses and Oilseeds*, revised ed. Oxford & IBH Publishing Co. Pvt Ltd.
- De, Sukumar. (2007). *Outlines of Dairy Technology*. Oxford: Oxford University Press.
- Girdharilal., Siddappaa, G.S and Tandon, G.L. (1998). *Preservation of fruits & Vegetables*. New Delhi: ICAR.
- Hall G.M. (1992). *Fish Processing Technology*. New York: VCH Publishers Inc.
- Kent. N.L. (2003). *Technology of Cereal*. 5th Ed. Pergamon Press.
- Lawrie, R. A. (1998). *Lawrie's Meat Science*. 5th Ed. England: Woodhead Publisher.
- Shai, Barbut. (2005). *Poultry Products Processing*. CRC Press.
- Srilakshmi. (2007). *Food Science*, 4th Edition. New Age International Ltd.
- Stadelman W. J. & Owen, J.Cotterill. (2002). *Egg Science and Technology*, 4th Ed. New Delhi: CBS Publication.

## ADDITIONAL RESOURCES

- H, Faride. (1997). *The Science of Cookie and Cracker Production*. New Delhi: CBS Publication.
- Marshall. (1994). *Rice Science and Technology*, Wadsworth Ed. New York: Marcel Dekker.
- W, B.Crusess. (2007). *Commercial Unit and Vegetable Products W.V*. Special Indian Edition. India: Agrobios India.

## TEACHING LEARNING PROCESS

Lectured based teaching, Power point presentations, Experimental learning through practicals.

## ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

## KEYWORDS

Department of Food Technology. Plant foods, Animal foods

### Facilitating the achievement of course learning objectives

Unit no	Course Learning Outcomes	Teaching and learning activities	Assessment tools
1	Understand different methods of fruits and vegetable processing	Lecture on importance of fruit and vegetable preservation, history and need of preservation. Detailed flowchart on Canning and bottling of fruits and vegetables, containers of packing, spoilage in canned foods. Fruits beverages: Introduction, process and preservation of fruit juices .Jams, jellies and marmalades: Processing and technology, defects in jelly.	Quiz, multiple choice questions, Flowchart preparation
2	Understand technical knowhow of Cereals, pulses and oilseeds processing	Detailed discussion on Wheat - Types, milling, flour grade. Rice – Variety, milling, parboiling. Corn – Variety,milling, Millets - milling. Pulses- Dry and wet milling, Oilseeds- Extraction of oil and refining.	Test
3	Understand processing of various spices, tea, coffee and cocoa	Processing and properties of important spices. Tea and Coffee: Processing	Test
4	Understand the compositional and technological aspects of milk and fish	FSSA Definition of Milk, Types of Market Milk, Physico-chemical properties of milk, Practical example based teaching on various processing techniques involved in dairy processing of milk, Flowchart of butter, ghee, flavored milk, yoghurt, dahi, shrikhand, icecream, condensed milk, milk powder, channa, paneer,cheese (cheddar). Lecture on classification of fish (fresh water and marine) using pictorial charts, composition of fish, characteristics of fresh fish, spoilage of fish, Power point presentations for chilling, freezing, drying, salting and smoking of fish.	Flowchart preparation
5	Understand the compositional and technological aspects of meat and poultry	Lecture on , composition of meat, carcass definition, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat, Concept of an abattoir,	Test

		process of slaughtering in an abattoir by showing a layout and explanation.	
6	Understand egg structure, spoilage and preservation	Detailed theory lecture on structure and preservation of egg, flowchart on egg powder manufacture.	Diagrams and flowchart

**\* Assessment tasks listed here are indicative and may vary.**

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